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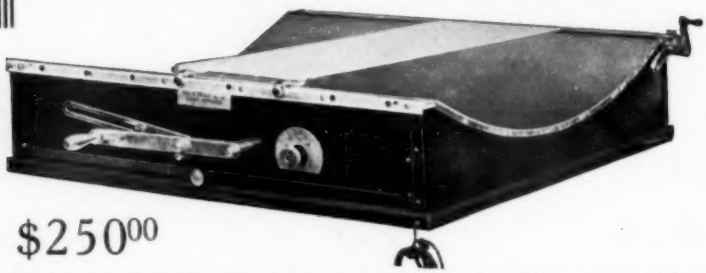

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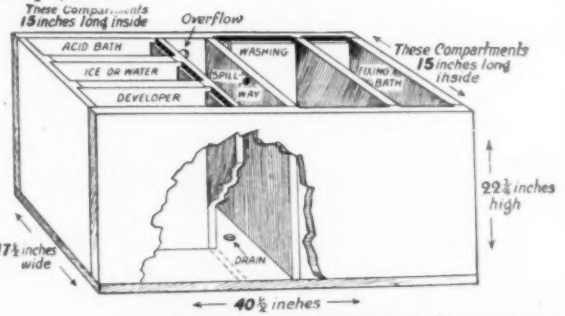

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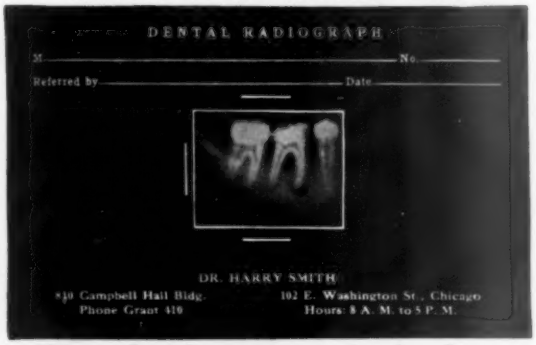

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XIII MAY, 1925 No. 5

THE SURGICAL TREATMENT OF CANCER OF THE BREAST*

BY E. STARR JUDD, M.D.

ROCHESTER, MINNESOTA

IN view of our present belief in the distinct clinical and pathologic entities in cancer, we are changing our ideas with regard to premalignant lesions. Formerly it was believed that every case of chronic cystic mastitis would become one of cancer if the patient lived long enough. It is true that cases are seen in which the same progressive lesion has existed for many years, and while formerly this was believed to be a benign condition changing to a malignant one, it is now believed that such long-standing lesions are usually malignant from the onset. Thus, it is more imperative than ever to make an early diagnosis of the tumors of the breast even if it is necessary to excise the tumor for final proof. People as a rule are now well posted on the dangers of neglecting a tumor in any region, and as a result the responsibility has been placed on the profession. Cases are continually appearing in which not only is it difficult to say what the tumor is, but whether there is any lesion present.

Needless operations must not be performed. The surgeon must be able to distinguish the difference between a tumor and diffuse mastitis, and to recognize the early signs of malignancy. Watching the development of a solitary tumor in the mammary gland does not show good judgment. Many girls and young women have bilateral mastitis without a distinct tumor. These conditions are always inflammatory in persons under thirty-five, and require no treatment unless they are producing symptoms. A solitary tumor in the breast should always be excised, no matter what the age of the patient, or how insignificant the lump.

The surgical treatment of cancer is based on the assumption that cancer originates in a solitary focus, which is unquestionably correct in most instances, but there are occasional cases in which lesions seem to occur in several places almost simultaneously. It is not always possible to recognize a cancer in the early stages, but it is probable that if all cancers could be removed while still confined to the tissue in which they originated, most of them could be cured. In many cases there is undoubtedly undemonstrable extension at the time of operation, but probably in cases in which the primary tumors have existed for some time. Cancer originating in the mammary gland spreads by direct extension and to the surrounding tissues through the lymphatics and blood vessels. Direct extension into the surrounding tissues is apparently a slow process as compared with the extension through the lymphatics and blood vessels. Usually by the time the deep fascia and tissues of the chest wall have become involved, producing a firmly fixed tumor, there are also many evidences of extensive lymphatic involvement and distant metastasis. Distribution of cancer by way of

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the lymphatics is of particular interest in cases of cancer of the breast. According to Handley, Poria, and Cuneo, there are six different routes of lymphatic drainage from the mammary gland. While any one of the six groups of nodes may be involved first, the nodes lying in the axilla along the axillary vessels are the ones first affected in about 90 per cent of the cases. For this reason operations for cancer of the breast always include removal of the axillary lymph nodes. The supraclavicular nodes may possibly, but very rarely, be affected first. They undoubtedly are much more often affected secondary to the axillary nodes. The nodes lying just above the middle of the clavicle have a direct connection with the structures of the mammary gland by the lymphatic vessels.

There are two groups of lymphatic vessels running through the intercostal muscles between the ribs. One group runs anteriorly to the sternum, then dips into the mediastinum, where it joins the mediastinal lymphatics. The other group runs posteriorly between the ribs and enters the mediastinal lymph nodes from behind. These intercostal lymphatic vessels undoubtedly carry cancer cells to the lymphatics in the mediastinum. In operating on cancers of the breast, we do not see lymphatic nodes between the ribs, and it is likely that there are none there. The subscapular nodes may often be seen lying on the subscapularis muscle involved in cancer cases, usually when the disease is rather extensive. Rarely are the nodes in the epigastric fascia involved in cancer of the breast. Being mindful of these six groups of lymphatic vessels and nodes which drain the breast, it is easy to see how cancer cells can be readily distributed, and why radical operation is necessary. It is also easy to understand how cancer can be distributed to the mediastinum fairly early. The frequency of metastasis to bone in cases of cancer of the breast shows that cancer is often spread through the blood stream, and while it is not possible to rule out such metastasis in all cases, nevertheless, a radical operation should not be undertaken for an extensive malignancy without the examination of some of the most likely sites of bone involvement.

DIAGNOSIS

Cancer of the breast is easily recognized in the later stages. In the early stages there is no visible difference between a cancer and a benign tumor. The first recognizable point of difference is attachment of the tumor to surrounding tissues. Often there is no sign of extension to the subcutaneous tissues before this attachment occurs. A benign tumor remains isolated and free in the breast tissue. When a tumor exists with a chronic mastitis, it is very difficult to determine whether the fixation is due to the associated inflammation in the breast. When the tumor shows the least sign of skin attachment, it is a certain indication of malignancy, even more accurate, I believe, than a microscopic examination. If we are careful to examine both the mammary gland and the tumor we can distinguish between a benign and malignant lesion in most cases. It should be emphasized that, in examining the breast, the entire mammary gland should be pressed out on the chest wall by the palm of the hand. In this way the gland is flattened out and the tumor may be palpated. When the mammary gland is taken between the fingers, as is often done, any little area of inflammation gives the impression of a tumor. If, after careful examination, there is any question about the nature of the tumor, it should be excised and examined grossly, and also microscopically if necessary. The gross appearance of a cancer of the breast is so characteristic that diagnosis can nearly always be made from it alone. Extensive experience with excision for diagnosis makes me emphasize the fact that a radical operation should be done immediately if it is indicated. The ultimate results are not so good when the radical operation is postponed.

In studying the question of operability in cases of extensive disease, besides considering whether there is local attachment, it is advisable to have roentgen-ray examinations made of the chest, and also of the pelvic bones and lumbar vertebrae. I have repeatedly refused to operate because of positive roentgen findings of the chest. On the other hand, I undoubt-

edly have operated in cases in which the mediastinal nodes were affected, only to find very early signs of metastasis. I have been unfortunate enough to have pathologic fractures occur very soon after radical operations on patients with no demonstrable evidence of a bone lesion. However, if it is reasonably certain that most of the malignant tissue can be removed, operation should be performed because it undoubtedly helps the defensive mechanism in its activities to limit the malignancy. On the other hand, it is not only useless, but decidedly harmful, to operate in the advanced case with small multiple skin nodules over the chest wall and extensive edema due to massive lymphatic involvement.

THE GRADATION OF MALIGNANCY

The different grades of malignancy are very well illustrated by cases of cancer of the breast. In a paper before the American Surgical Society in Washington three years ago, Lee, of New York, brought this out in a very striking manner. He first showed the photograph of an elderly patient who was very obviously suffering from cancer of the breast. Her history indicated that she had had this condition for twenty-three years and that she had had no treatment. This undoubtedly had been a very slowly developing cancer of the mammary gland. In contrast to this, the next photograph was of a woman with a large cancer of the breast, who had died from extensive malignancy six months after the tumor was discovered. It is clear that these two patients had had quite different types of malignancy.

Broders, from a study of epithelioma, has shown that it is possible to estimate the degree of malignancy by the histologic picture of the tumor, so that we can now make a much more accurate prognosis than formerly. It is interesting to note, in studying the results of operative treatment for cancer of the breast, that this gradation of malignancy is suggested in almost every report. Such gradation probably explains why six of Halsted's presumably most favorable cases, so considered because there was no lymphatic involvement at the time of operation, had recurrences very soon after operation, and all six patients died within a year. It also explains why many of the patients with more advanced cancer of the breast have remained well many years after operation. In view of this knowledge, we must be guarded about pronouncing a case hopeless, but we must be equally guarded in making a favorable prognosis, at least until the microscopic study has been completed.

THE RADICAL OPERATION

The radical operation for cancer of the breast is much more than an amputation of the mammary gland. The cancer cells are disseminated through the lymphatic vessels and nodes, which are distributed throughout the fascia, so that in order to remove them satisfactorily, complete excision of the muscles and fascia of this region is necessary. A simple removal of the axillary nodes is not sufficient. While this operation is of considerable magnitude and apparently mutilating, nevertheless it is seldom followed by shock. Healing is rapid and complete, and the functional result as concerns the arm and shoulder is usually perfect. The operation is attended by practically no mortality. Attempts have been made to develop a still more radical operation, removing the supraclavicular nodes, and at times a part of the chest wall. These have generally been unsatisfactory, not so much from the immediate results of the operative procedure, but because usually when it was necessary to proceed so far to remove the cancer, it had already invaded more distant regions. While massive removal of cancer undoubtedly helps the protective mechanism, this particular practice of removing the supraclavicular nodes in radical operations for cancer of the breast, was carrying the point too far. The same objection may be raised to carrying the dissection down to, and including excision of, the umbilicus. The fascia over the upper part of the recti muscles, together with the fascia and adipose tissue between the upper ends of the muscles, should be included in the excision, but I do not feel that routine removal of more of the abdominal wall is advisable.

RESULTS OF SURGICAL TREATMENT

Good results from surgical treatment of cancer of the breast depend more on early operation than on extensive procedures. Some of the early cases start with a high degree of malignancy and will recur in spite of early and radical treatment, while some of the fairly advanced cases, because they are of a lower degree of malignancy, will be cured by operation. In view of the fact that so much has been accomplished by radiotherapy in advanced cases, it is very doubtful whether surgery should ever be used in advanced conditions. I have seen cases in which an absolutely inoperable malignancy was apparently arrested by these agencies, and I have seen others that did not respond to such treatment, probably because of the high degree of malignancy. When radiotherapy is once instituted in a case, it is usually continued even though sometimes an inoperable condition seems to become operable. Radiotherapy has been employed in the Clinic before operation in operable cases, and following operation in favorable, as well as unfavorable cases, but it is not as yet possible to estimate its value accurately. That in some instances it has had a very decided effect on the growth is certain. A series of cases so treated would have to be compared with another series in which surgery alone was used, and furthermore it would be necessary to take into consideration the relative degree of malignancy, before an estimate could be made of the value of combined surgery and radiotherapy.

CONCLUSIONS

1. Progress in the development of the surgical treatment of cancer of the breast is being made through a better understanding of the clinical and pathologic aspects of the types and grades of cancer.

2. That cancer originates in a single focus is probable; the avenues of its extension from the mammary gland are well understood.

3. A radical operation, in which the adjacent fascia, muscles and lymphatics are removed, is essential in all operable malignant cases, but in spite of this procedure there will be early recurrences in certain apparently favorable cases. On the other hand, many patients in whom the disease is obviously extensive will remain well.

4. In estimating the result of treatment for cancer of the breast it is obviously necessary to take into consideration the type and grade of malignancy dealt with. In a series of cases, in which the malignancy is of low grade, the results are sure to be better than in one composed almost entirely of highly malignant cases.

5. There is very good evidence of the beneficial effect of radiotherapy alone in certain cases, including those in which recurrences have followed surgery, but there is every reason to believe that some combination of surgery and radiotherapy can be found which will do more than either one alone. If careful observations are made, they should lead, in a few years, to an accurate estimate of the combined treatment.

THE VALUE OF POSTOPERATIVE IRRADIATION IN MAMMARY CARCINOMA*

BY

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MUCH discussion centers about the question of postoperative radiation in mammary carcinoma radically operated upon. The statistics gathered for the last three years show in part a decrease, and in part an increase from the average in recurrences following postoperative radiation. The conclusions reached by the different authors, however, are based purely upon clinical observation and obviously, the individual technique of exposure and the dosage used by the different authors are entirely responsible for the variation in the results obtained. No experimental data were reported with regard to the healing or damaging action of the roentgen rays. The subject of local immunity is a new development and only recently has the question of prophylactic irradiation of the normal tissues been studied from the experimental point of view.

FIG. 1. Recurrent carcinoma nodule in the unexposed skin between two areas treated by irradiation. No recurrence in the exposed areas.

FIG. 2. Small recurrent carcinoma nodule in the unexposed skin between two areas treated. The lesion in the treated areas has entirely disappeared and there was no further recurrence or metastasis in these areas. The nodule together with 5 cm. extension of the exposed skin was removed for microscopic examination.

Murphy, Maisin and Sturm[1] have proven that roentgen rays given over an area of skin in an erythema dose, render this area highly resistant to a subsequent inoculation with a transplantable cancer. In order to produce conditions similar to the disease in man, these authors used for their experiments autografts of spontaneous cancer of mice and inoculated them in areas exposed to an erythema dose of roentgen rays. They found that the autografts failed to grow in the majority of instances (71.4 per cent), while control grafts inoculated into untreated areas grew in a large proportion of the animals (83.6 per cent). From further experiments they concluded that the failure of these autografts to grow in the exposed area was due to the reaction in the normal tissues induced by the roentgen rays.

The postoperative radiation in mammary carcinoma produces a similar reaction of the normal tissues, which brings about conditions leading to the destruction of the remaining carcinoma cells. This

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view is supported by our clinical observations for the past two and one-half years. In 90 patients treated for post-operative carcinoma of the breast, where in the majority of cases a single exposure of S.U.D. was given (by using deep rays of an efficient wave length of 0.13 Å., 200,000 volts, 1 mm. Cu and 1 mm. Al as filters) we never observed a recurrence in the areas exposed. However, in two of our cases a recidive developed in the skin which was left unexposed between two areas treated.

The first case was a patient who had a mass in the left breast of about one year's duration. A radical operation was performed a year and a half ago and the pathological report was squamous cell carcinoma with involvement of the axillary and subscapular glands. Roentgen treatment was given three weeks following the operation over the entire left half of the chest, the left axilla and both supra- and infraclavicular and cervical regions; 100 per cent S.U.D. was administered by using 200,000 volts, with 1 mm. Cu and 1 mm. Al as filters. Patient returned for re-examination about one year following the roentgen treatment. At this time there was a nodule about one inch in diameter and half an inch elevation between the two areas previously exposed (Fig. 1). There was no evidence of recurrence or metastases in any of the areas treated. Unfortunately, this patient refused further medical treatment so that no other observation could be made regarding the disease.

In the second case, there was a carcinoma simplex of the right breast removed twelve years ago. For ten years following the operation, the patient was well, but about two years ago a recurrence developed

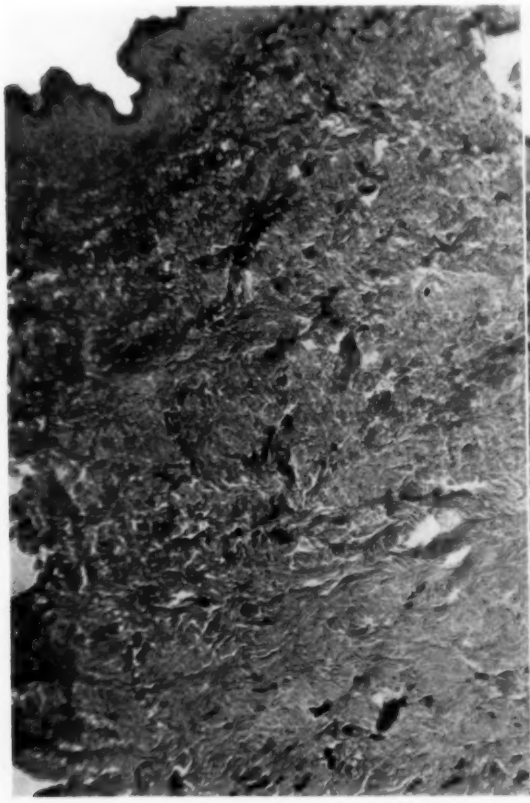

FIG. 3. Microscopic section of the recurrent nodule in the unexposed area. The skin and subcutaneous tissues above the nodule show normal appearance; in the deeper tissues foci of actively growing carcinoma forming the recurrent nodule, are present.

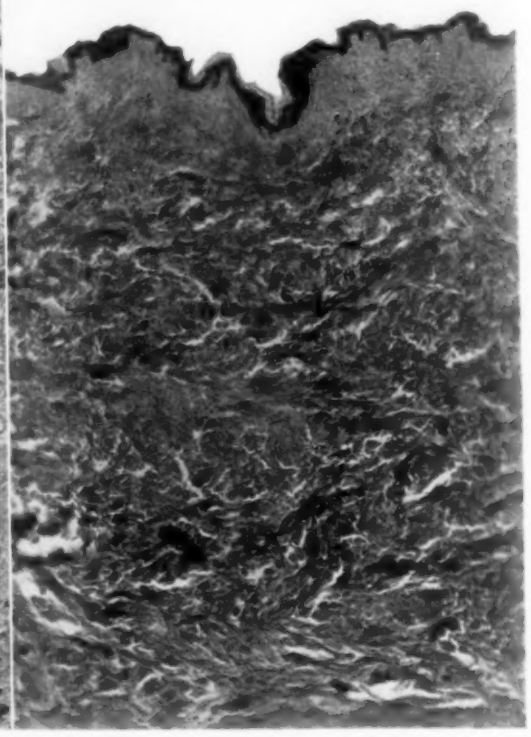

FIG. 4. Microscopic section of the skin and underlying tissues exposed to radiation. There are no carcinoma foci present.

below the lower part of the scar. The tumor was the size of a small orange and was adherent to the deep tissues. There was no ulceration of the skin present over the tumor. Two series of deep roentgen therapy (100 per cent S.U.D. each time) were given at two-month intervals, and the lesion entirely disappeared. At the present time, almost two years following the roentgen treatment, a small recurrent nodule has developed in the unexposed skin between the two areas treated (Fig. 2). No other recurrence or metastasis was present in the exposed areas. The nodule, together with about 5 cm. extension of the exposed skin, was removed and a microscopic examination made. Serial sections show that in the unexposed area, active carcinoma was present (Fig. 3), while in the exposed area no carcinoma cells could be demonstrated (Fig. 4).

These two cases, we believe, prove that roentgen radiation rendered the areas of the skin exposed highly resistant to carcinoma. In the first case there was no recurrence in the exposed areas, and one year following the treatment there was a nodule in the skin left free between the two areas treated. In the second case, the lesion in the exposed area entirely disappeared and almost two years later a recurrence developed also in the unexposed skin between the two areas treated. An immunity towards cancer in the exposed areas must exist. Murphy, Maisin and Sturm[1] have experimentally proven that this immunity is due to the cellular reaction in the normal tissues induced by the roentgen rays. Whether this cellular reaction is a primary radiation effect, or whether it is merely a secondary inflammatory reaction brought about by the destruction of epithelial cells by the roentgen rays is not definitely proven as yet. Murphy, Maisin and Sturm have exposed actively growing inoculated autografts of mice cancer to an erythema dose *in situ*, after which they removed the irradiated tumor and reinoculated it into an unexposed area. In 78.8 per cent the irradiated tumors grew well in their new location, proving thus that there is no direct damage to the cancer cells, but that the beneficial effect is brought about by the cellular reaction induced by the rays as a primary radiation effect on the normal tissues. On the other hand, Warren and Whipple,[2] from experiments performed on the intestines of dogs, concluded that roentgen rays produce destruction of the epithelium of the capillaries—and in a similar way of the tumor cells—, and that the coagulated tissue in turn leads to rupture of the capillaries and hemorrhage. As a result of the thrombosis formation in the ruptured vessels, a secondary inflammatory reaction develops, fibroblastic tissue is thrown out and connective tissue formed. However that may be, there is no doubt that the cellular reaction of the normal tissues plays a very important part in the curative process of carcinoma.

FIG. 5. Numerous recurrent carcinoma nodules in overdosed areas. No nodules developed beyond the margins of the areas exposed to radiation.

If, for some reason or other, a cellular reaction fails, no amount of radiation will succeed in killing the tumor. In fact, the tumor will grow more actively. Such a condition may arise in any over-irradiated tissue. Two of our cases show evidence of the damaging effect of roentgen-ray exposures in such instances.

In one of the cases there was at the time of the treatment a carcinoma of both breasts with metastases to the adjacent glands and to the skull. The primary lesion, as well as all of the visible metastases, was treated with 130 per cent S.U.D. of deep roentgen rays. There was a marked

improvement in the patient's condition following the treatment and two months later treatment over the breasts was repeated. The patient felt well for a period of six months following the second treatment. The lesions of the breasts and most of the metastases disappeared. Later, however, a recurrence in the exposed areas of the breast developed. This was in the form of skin nodules, the process spreading very rapidly. In a few weeks all the exposed areas were involved by such nodular metastases, but no nodules developed beyond the margins of the areas treated (Fig. 5).

In the second case, the patient had a squamous cell carcinoma of the left breast which was radically removed six years ago. Following the operation several courses of superficial treatment were given over the entire left half of the chest and over the left cervical region. After one of the exposures a severe second degree erythema developed, which later entirely healed. We first saw the patient about two years ago and the question of deep roentgen treatments was considered. At that time the skin over the whole left half of the chest and the left supraclavicular region showed marked sclerosis and telangiectasis. In places there was a deep infiltration of the subcutaneous tissues with marked sensory disturbances. The demarcation towards normal skin was in part sharp, in part diffuse (Fig. 6). On account of the marked skin changes, only 50 per cent S.U.D. was given by using rays of an efficient wave length of 0.13 Å. There was no reaction following this treatment. The patient felt well until recently when she returned for an examination. At this time we found a very deep induration of the skin, extending practically over all the left half of the chest, going over to the supraclavicular region and invading also the lateral chest wall at the level of the sixth rib, extending backwards as far as the scapular line. At the edge of the induration the skin showed a nodular appearance, somewhat suspicious of recurrent carcinoma foci. There was considerable swelling of the left arm due to the induration in the left axilla (Fig. 7). One of the nodules with surrounding skin was excised for microscopic examination. A marked sclerosis of the skin with actively growing carcinoma cells in the deeper tissues was present. The basal cells of the epidermis having been in their majority destroyed, the epithelium was reduced to only a few layers of cells which showed very poor staining. The hair follicles and sebaceous

FIG. 6. Marked atrophic changes of the skin and underlying tissues as a result of numerous "superficial" roentgen treatments. Second degree erythema at the time of treatment.

FIG. 7. Same patient, about two years later. Very pronounced atrophy of the skin with deep induration of the underlying tissues. Elephantiasis of the left arm due to induration in the left axilla. Numerous carcinoma foci scattered throughout the entire skin treated by radiation. No carcinoma foci in the untreated skin. One of the carcinoma nodules together with 2 cm. surrounding skin removed for microscopic examination.

glands showed severe degenerative changes. The corium showed flattening or entire disappearance of the papillary bodies and as a result of the destruction of the capillaries, there was a very poor blood supply of the reticular layers. The connective tissue itself showed a formation of thick collagen bands with marked hyalinazation in places (Fig. 8). Actively growing carcinoma cells were present between these thick fibrotic bands showing signs of rapid extension (Fig. 9).

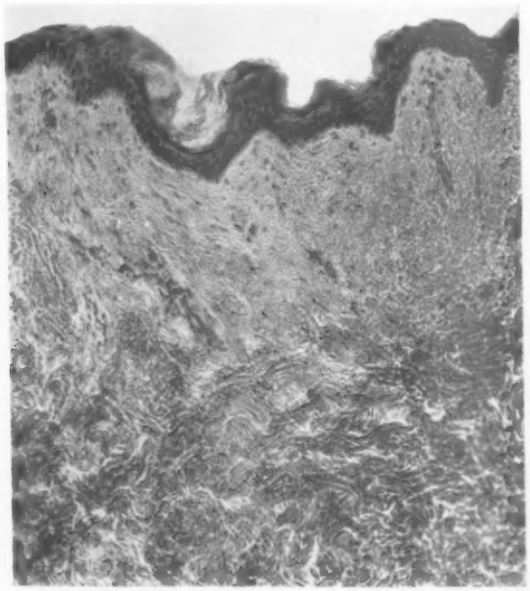

FIG. 8. Microscopic section of the skin exposed to repeated doses of heavy irradiation. The epithelium is reduced to a few layers of cells. There is flattening of the papillary bodies and almost total destruction of the capillaries. Thick bands of fibrotic tissue showing hyalinization replace the reticular layers.

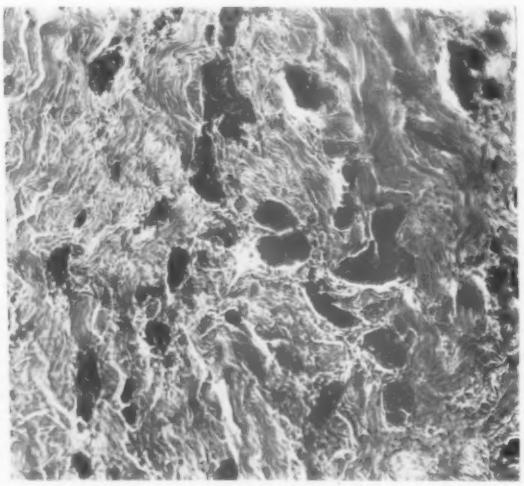

FIG. 9. Microscopic section of a recurrent carcinoma nodule in an area severely injured by repeated doses of heavy irradiation. There are actively growing carcinoma foci between thick bands of hyalinized fibrous layers. There is rapid extension of the carcinoma.

There can be no doubt that owing to the destruction of the capillaries and to the poor blood supply of such tissues, a locus minoris resistentiae was created. If cancer cells are implanted in such a tissue, they will grow rapidly and further roentgen exposures will be of no avail.

CONCLUSIONS

There is a beneficial action of roentgen rays in the postoperative stage of mammary carcinoma. A local tissue reaction is produced by the irradiation which brings about immunization against carcinoma.

It is essential that the dose should be within the limit of the tolerance of the normal tissues—it should not exceed 100 per cent S.U.D.

A destruction of the protective normal tissue around the lesion will produce aggravation of the disease.

We are deeply indebted to Dr. P. F. Morse, chief pathologist for Harper Hospital for the pathological assistance.

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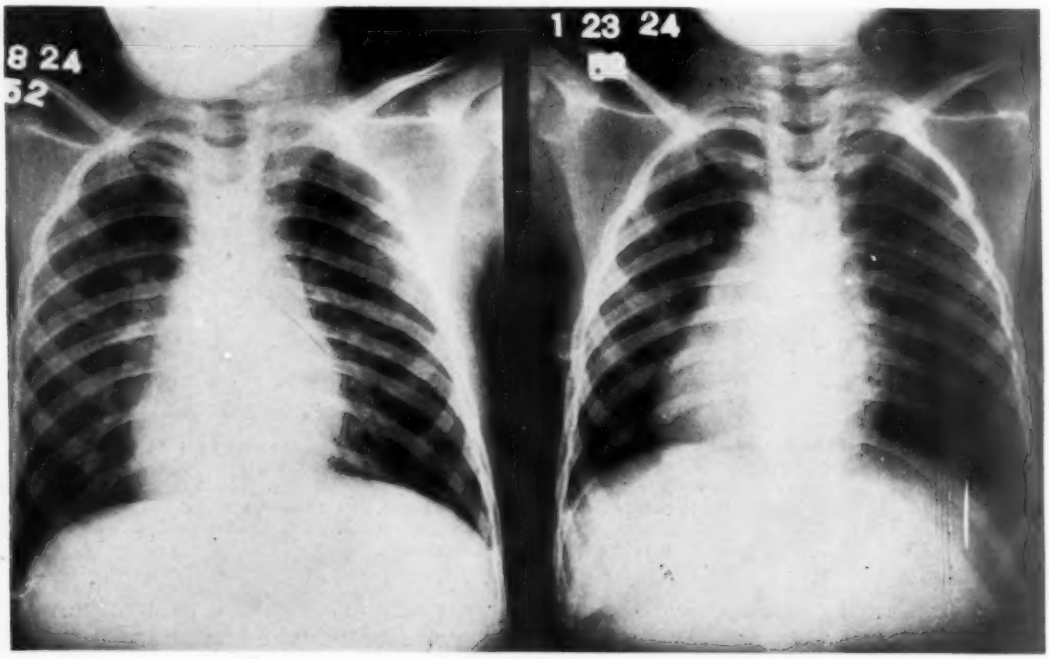
FURTHER OBSERVATIONS ON THE USE OF THE ROENTGEN RAY IN PERTUSSIS*

BY RALPH D. LEONARD, M.D.

IN a previous communication to this Society we brought to your attention the possibility of roentgen radiation being of some value in the treatment of pertussis.[1] The object of this paper is to present further evidence which has been accumulated during the past year of the beneficial action of this form of therapy and also to demonstrate some of the roentgenographic findings in the chests of pertussis patients. We have been encouraged by noting in the literature that similar studies are being carried on in other parts of this country and abroad. Kingston and Faber of California report favorable results in a series of cases. Struthers of Toronto has recorded similar improvement in cases treated by this method. We have received many personal communications citing series of cases treated with roentgen radiation, the results of which seem to confirm our observations.

You may remember that our first year's work consisted of a study of 300 to 400 out-patients, carried on in the On Shore Department of the Boston Floating Hospital. Of necessity, out-patients do now allow the accurate and careful observation which is essential for research work of this type, since we had to depend many times upon the opinions and observations of the parents.



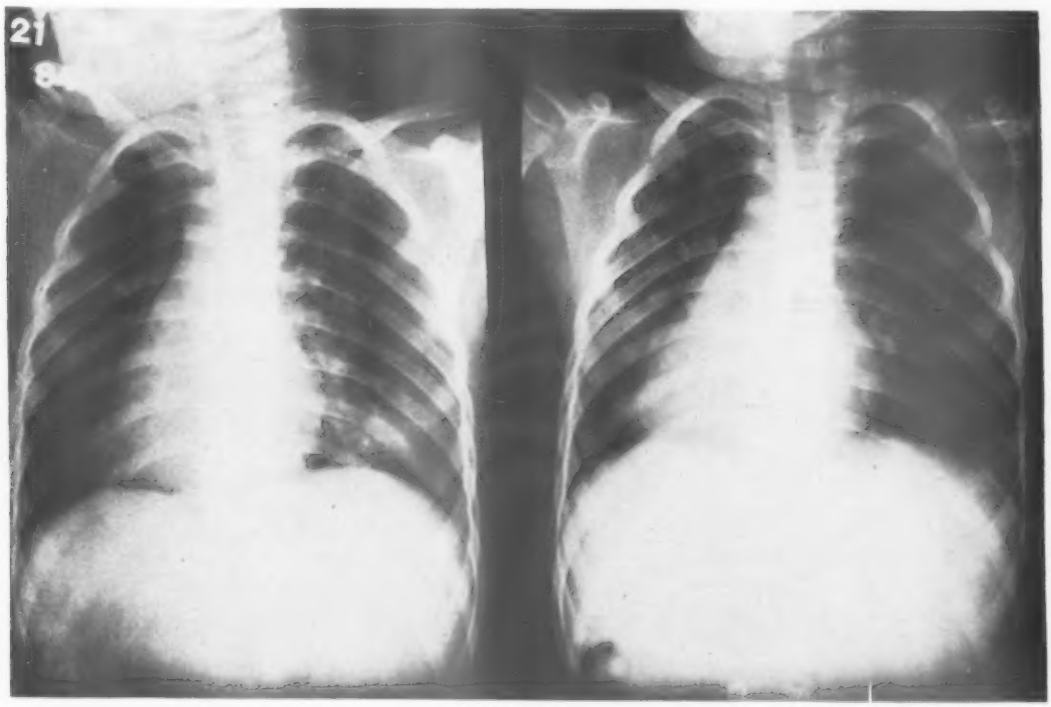
Before FIG. 1. After

Our work this year has consisted mainly in an intensive study of 20 cases of uncomplicated whooping cough, which have been carefully followed in the wards of the Boston Floating Hospital. These patients were admitted to the hospital and kept under constant observation by an efficient corps of nurses and the resident physician. In addition to these 20 house-patients, we also continued the out-patient clinic, in which we observed and treated 200 individuals. The cases for our intensive study in the hospital were picked more or less at random from the

[1] LEONARD, RALPH D. Use of the roentgen ray in pertussis. AM. J. ROENTGENOL. & RAD. THERAP., 1924, xi, 264–267.

* Read at the Twenty-fifth Annual Meeting, AMERICAN ROENTGEN RAY SOCIETY, Swampscott, Mass., Sept. 3–6, 1924.

out-patient clinic, purposely, however, securing as early cases and as young children as possible. Eighteen of the 20 patients were three years of age or under; 17 were in the first three weeks of the disease, symptomatically. The average age of the patients was just under twenty-six months and the average duration of the disease at the time of admission was about two and one-half weeks. This series is too small to allow conclusions as to the relative benefit of treatment in the various age groups and in the different stages of the disease. For this data, we are forced to turn to the out-patient group which we reported previously, concluding that the youngest patients and the earliest cases seem to derive the greatest benefit.



Before FIG. 2. After

In general, the dosage employed was the same both for the intensively studied house-patient and the out-patient. This year, in our work, we have varied the technique to some extent. The patients still receive three routine treatments at 48-hour intervals. We do not hestiate to give further treatments if the symptoms still persist. Some of the patients receive as many as six or seven treatments. Instead of covering the entire chest and throat, in many of the cases we have localized the treatments to areas covering the roots of the lungs, both front and back being treated at the same visit. We have also diminished the distance from 24 to 16 inches and have thus increased the total amount of radiation given in three treatments from perhaps a third of an erythema dose to nearer two-thirds of an erythema dose. In neither technique have we discovered, or is there any reason to expect, bad effects, the total amount of radiation given being well within the erythema dose. The results from this intensive treatment I think are, on the whole, better than with the previous method. We feel that there is opportunity for further modification of the treatment. For instance, there may be localized treatment over the larynx in addition to the roots of the lungs, as has been suggested by Dr. Lange of Cincinnati.

The most striking result in the treatment has been in the reduction of paroxysms. This reduction has been not only in the

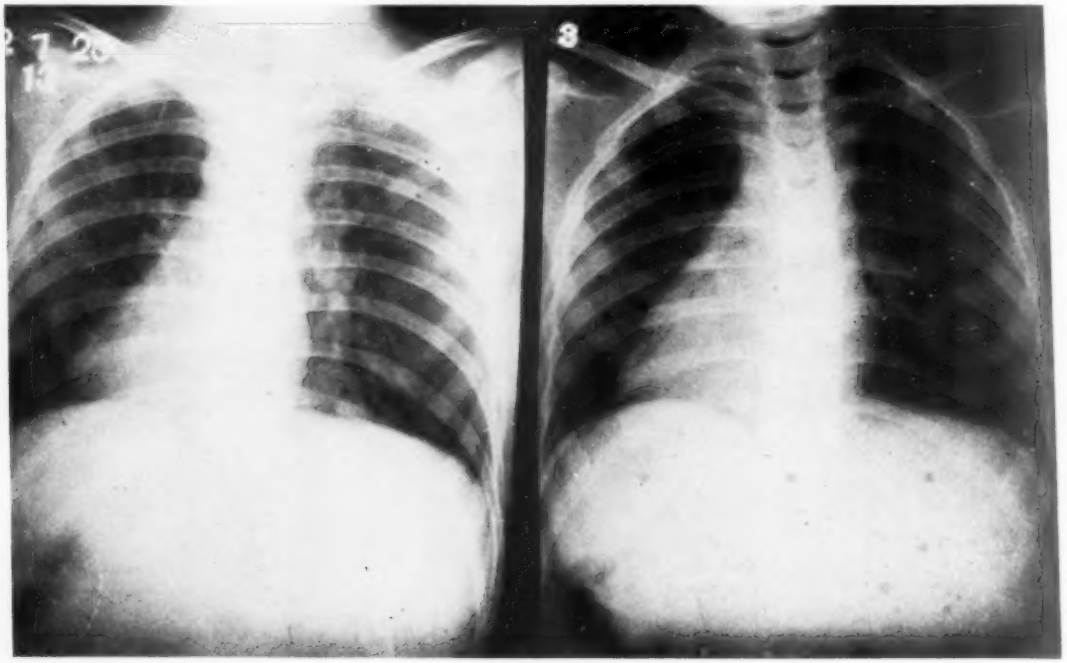
number but in the severity of the paroxysms. This can be seen by Chart 1.

On the day of admission, these 20 cases had a total of 288 paroxysms. On the fifth day after treatment was started, only 157 paroxysms were recorded and in general they were much less pronounced in severity. By the tenth day, this was further reduced to 96, and at the end of the two weeks, only 43 paroxysms were noted.

It will be argued that theoretically the paroxysmal stage of the disease is of only two weeks' duration anyway. In answer to this argument, we feel justified in stating that so far as we are able to draw conclusions from the data at hand, the same diminution in the number and severity of the paroxysms occurs whether the disease is at the onset or later on in the paroxysmal stage. This view is fairly well supported by our observations in the larger group of patients followed in the out-patient department, now numbering over 500. To bring out this point, the three following charts are presented to illustrate typical cases (Chart II).

The first of these is that of a four months old infant in the first week of the disease. It represents a very severe case. The second is an average case, a child of two years of age, in the third week of the disease. The third is a mild case in a child three years old, in the fourth week of the disease. You will note from the table that the curve indicating the number of paroxysms is practically the same in all 3 cases. You will also note from the curves that not only the actual number but the severity of the paroxysms is diminished.

The blood has been carefully studied in these cases, but I will not go into this phase of the work except to say that normally in whooping cough there is an initial lymphocytosis which reaches its maximum in three weeks and then drops gradually back to normal. Under roentgen treatment, we find that the blood picture roughly parallels the clinical improvement, that there is an early drop in the lymphocytosis corresponding to the reduction in the paroxysms.



Before FIG. 3. After

We have been more successful in the bacteriological study of these cases this year than we were previously. This problem I will not go into either, except to say that we were able to isolate the Bordet-Gengou bacillus from 6 of our 20

cases. In none of our cases were we able to obtain a positive culture after the third week. However, we are unwilling to state at the present time any conclusions regarding the effect of roentgen treatment and the positive cultures.

In conclusion, I may say that the intensive study of 20 cases allows the same conclusions as were drawn last year from a study of 400 cases, namely;

(1) Roentgen radiation produces a diminution in the number and severity of the paroxysms in over 75 per cent of the cases, controlling particularly well the vomiting spells.

(2) The somewhat increased dosage seems to give correspondingly better results.

(3) The younger patients seem more susceptible to the benefits of roentgen radiation.

(4) The roentgenographic findings would seem to indicate that the beneficial results may bear some relation to the effect which the roentgen rays have on the bronchial lymph glands.

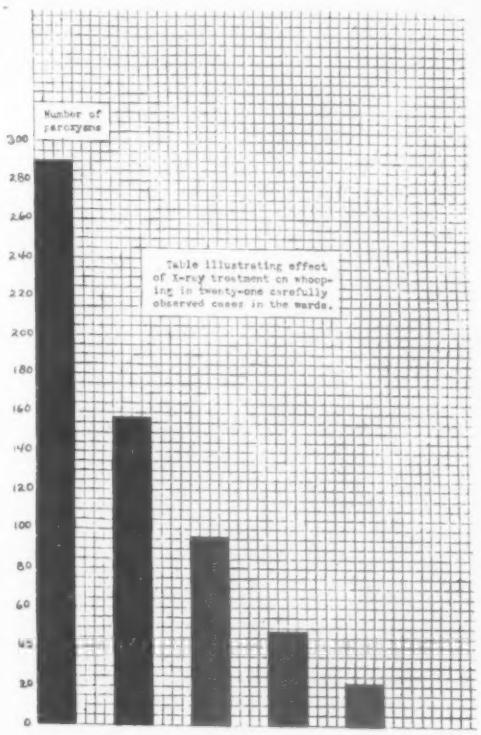


CHART I.

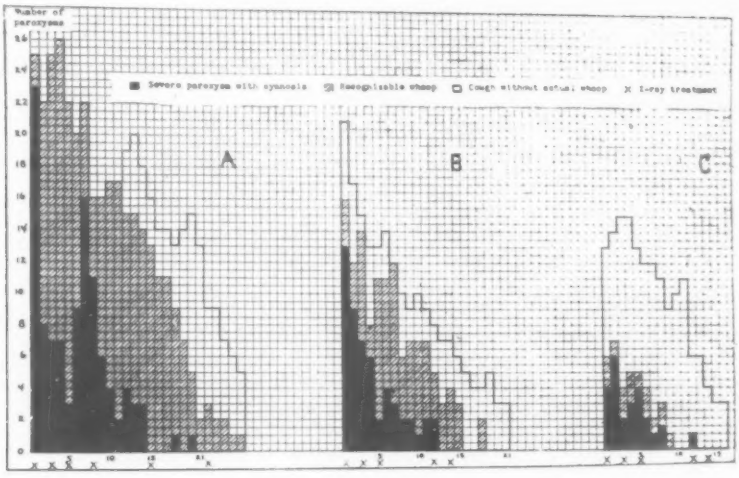


CHART II.

ROENTGEN-RAY TREATMENT OF TONSILS AND ADENOIDS*

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IN a previous report the results of the roentgen-ray treatment of the tonsils and adenoids in 14 patients were presented.[1] The observations showed a measurable decrease in the size of the tonsils in some of the patients and a definite clinical improvement in the symptoms over the short period of observation. Since then, the observations have been extended over a period of eighteen months and include bacteriological and pathological studies which make them worth recording despite the smallness of the series. The roentgen-ray treatment has been used in many clinics and by many individuals throughout the country, only to be discarded after a few spasmodic efforts. The reason for the failure has often been the indiscriminate treatment of all types of patients. The object in completing these observations was to determine if the good clinical results previously noted, had persisted and to determine, if possible, what type of case was benefited.

For details of the technique of treatment and the procedure followed one is referred to the original article. The patients received a series of 8 treatments—4 treatments at 4-day intervals and 4 similar treatments after a lapse of three to four weeks. The roentgen radiation was applied only over the tonsillar regions externally so that the adenoids were affected but incidentally. The patients were observed on several occasions up to a period of four months. They were seen again at nine months and eighteen months after treatment. Bacteriological studies were made at all these observations. The pathological studies came from the group of patients in whom the treatment was unsuccessful. There were 4 in this group. In addition, the tonsils and adenoids from 5 patients not in this series but in whom the amount of treatment was known, were studied microscopically. If the effects of roentgen treatment could be noted in the sections of the unsuccessful cases, surely the effect would be much more marked in those who were benefited by the treatment.

CASES SHOWING DEFINITE CLINICAL IMPROVEMENT (8 cases)

The complaints of the 6 children (D. T. aged six; C. S. aged nine; W. R. aged nine; A. S. aged eleven; C. H. aged twelve; P. K. aged twelve) were frequent colds, sore throats and mouth breathing. In every case the cervical glands were palpably enlarged and the tonsils were large, soft and not adherent (typically hyperplastic tonsils of early childhood). Following the series of treatments each of these patients showed marked amelioration of symptoms. Objectively, during several observations within six months of the treatment, the tonsils appeared definitely shrunken, as noted in the previous publication; but there was no appreciable effect on the cervical adenitis.

All of these patients returned for observation eigthteen months after their last treatment. All but 2 reported that they had remained free from colds and sore throats and difficulty in breathing. These two patients had had one or two colds but were satisfied that they were definitely improved. However, on examination, the tonsils did not appear shrunken but appeared much the same as before treatment. It must be stated that accurate measurements were not made as in the earlier observations so that this is merely an impression.

One patient included in this group had chorea. He followed the same course as the other children as far as colds and sore throats were concerned. However, there was no effect to be noted on the chorea.

The adult patient, B. T. aged fifty-six, had infectious arthritis along with fre-

* The patients in this study were seen in the Laryngological Clinic of Dr. S. J. Crowe, Johns Hopkins Hospital

quent sore throats. Not only the sore throats had disappeared but the patient had had no arthritis since her treatment. The shrinkage in the size of the tonsils first noted persisted over a period of eighteen months.

CASES SHOWING NO CLINICAL IMPROVEMENT (6 cases)

(R. C. aged eleven; D. N. aged eight; R. W. aged nineteen; E. W. aged ten. R. B. aged five, all previously reported.) These patients received only one series of treatment. As improvement was not sufficiently rapid the first 3 had their tonsils and adenoids removed at operation and the other 2 were lost track of. These can hardly be counted as failures since the treatment was insufficient.

There was one very definite failure. B. S., aged seven had two complete series of treatments and yet the colds and sore throats were just as frequent as before. Her symptoms entirely disappeared after her tonsils and adenoids were removed at operation.

BACTERIOLOGY

Cases were studied for the presence of beta hemolytic streptococci in the tonsillar crypts and nasopharynx. Eight patients having two complete series were studied bacteriologically. These were the 8 patients reported as showing definite clinical improvement. The bacteriological findings were previously reported on all these patients except one, P. K., which are reported for the first time. As studies on 5 of these 8 previously reported extended only over one month after treatment it was felt that they were incompletely studied. In the case of B. S., who received two full series of treatments without benefit, a persistence of the carrier state was noted in the previous report. She is not reported again as an operation was performed shortly after her last treatment.

It can be seen at a glance that the carrier state has persisted in every case but one, B. T. This is sufficient to show that roentgen treatment does not "result in an opening of the mouths of the crypts and their sterilization by improved drainage." So-called sterilization is not necessary for clinical improvement. In fact the recent studies of Bloomfield show that the carrier state is accompanied by a certain degree of immunity.

Case	Time after Last Treatment	Cultures	Hemolytic Streptococci
1. E. H. previously reported "free of hemo. strept."	4 months	Both tonsils	++
		Pharynx	0
	9 months	Both tonsils	+++
		Pharynx	0
2. W. R. previously reported "persistence of carrier state"	4 months	Right tonsil	++
		Left tonsil & pharynx	0
	9 months	Both tonsils	+++
		Pharynx	0
3. B. T. previously reported "persistence of carrier state"	4 months	Both tonsils & pharynx	0
	9 months	Both tonsils & pharynx	0
4. A. S. previously reported "free of hemo. strept."	4 months	Left tonsil	++
		Right tonsil & pharynx	0
	9 months	Left tonsil	++
		Right tonsil & pharynx	0
5. C. S. previously reported "free of hemo. strept."	4 months	Both tonsils & pharynx	0
	9 months	Left tonsil	+
		Right tonsil & pharynx	0
6. H. C. previously reported "free of hemo. strept."	4 months	Both tonsils & pharynx	0
	9 months	Both tonsils	+++
		Pharynx	0
7. D. T. previously reported "free of hemo. strept."	4 months	No cultures	
	9 months	Right tonsil	+++
		Left tonsil & pharynx	0

P. K. First series 11–11 to 12–3
Second series 2–2 to 2–18

Date of culture	Culture of	Hemo. Strept.
11/9	Both tonsils and pharynx	+++
11/23	Both tonsils and pharynx	+++
12/2	Right tonsil	++
	Left tonsil	+
	Pharynx	0
4/29	Both tonsils and pharynx	0
9/9	Left tonsil	+++
	Right tonsil and pharynx	0

PATHOLOGY

The work of Warthin, Murphy and his associates, and Von Glahn indicate that the roentgen-ray in doses such as were used in this treatment, has a specific destructive action on lymphoid tissue. The pathological change to be expected then is a diminution of the lymphoid tissue especially the germinal centers of the lymph follicles, with a replacement by fibrous tissue.

In examining for changes in the tonsils and adenoids certain factors must be considered. The tonsils and adenoids are most active in early childhood. The hyper-

trophy is due to a hyperplasia and symptoms result from mechanical disability. At puberty they diminish in size unless there has been sufficient infection to cause a state of local sepsis. A standard for comparison must be formulated in any study of the pathology of the tonsils and adenoids.

In children suffering with colds and sore throats or obstruction to breathing, the tonsils appear very large, often meeting in the midline. They are not adherent. The crypt orifices are prominent. The tonsils feel very soft on palpation. On section the one prominent feature is hyperplasia. There is a great increase of the lymph follicles and in the size of the germinal centers. The hypertrophy depends on an actual increase in the lymphoid tissue. The crypts are not prominent. Usually they are very narrow with thin epithelium as if the crypts were crowded by the lymphoid tissue. There is very little evidence of any chronic inflammatory reaction.

In adults the condition is quite different. As a rule mechanical disability plays little rôle. The indications for operation are very definite and the symptoms much more severe. Examination usually shows tonsils which are large but not prominent, adherent to either the anterior or posterior pillars, scarred and often with occluded crypts. On palpation they are usually firm. Frequently caseous-like material can be expressed from the crypts. On section hyperplasia is not prominent. The follicles are smaller and less in number than in children. Fibrosis is more prominent. There is evidence of chronic inflammatory reaction in the crypts,—the crypt epithelium is desquamated and keratinized; the crypts may be plugged with cellular debris and masses of bacteria; often there is definite ulceration of the crypt epithelium with a thrombosis of numerous blood vessels in the immediate vicinity. Areas of necrosis in the adjacent follicles have been described but are very hard to demonstrate.

The above standards have been determined after a study of over 2,000 sections of the tonsils and adenoids removed at operation.

SECTIONS OF THE TONSILS AND ADENOIDS FROM CHILDREN TREATED BY ROENTGEN RAY

1. B. S., aged seven; 8 treatments; operation 113 days later.

Left Tonsil. Very markedly atrophied; marked increase of the fibrous capsule with hypertrophy of the mucous glands in it. There are two areas of lymphoid tissue which have persisted but the follicles are not prominent. However, lymphoblasts are definitely present in these follicles. There is one area in which the lymphoid tissue is definitely disappearing to be replaced by fibrous tissue. This area lies just beneath the faucial surface and occupies about one-half the tonsil. The outlines of the follicles cannot be made out.

Another section of the same tonsil presents about the same picture and also shows a crypt wide open and containing no cellular debris.

Right Tonsil. Larger than the left. There is a definite atrophy of some of the lymphoid tissue with an increase of fibrous tissue trabeculae. The changes are much less marked than in the left tonsil but the follicles are not so numerous nor so prominent as in the "standard" tonsil for this age.

Adenoids. Small, epithelium intact. Atrophy only slight as in the right tonsil.

2. D. N., aged nine; 4 treatments; operation 372 days later.

No effect on either tonsils or adenoids. They are typically infantile hyperplastic tonsils and adenoids.

3. L. B., aged seven (not in this series). Patient had tuberculous cervical adenitis on the right side.

Left Tonsil. Tonsil only about half the "standard" size. There is very definite atrophy with marked increase in the fibrous capsule. Follicles few in number but of normal size. Very few mitotic figures to be seen in the germinal centers.

Right Tonsil. No tubercles. There is only very slight atrophy. For the most part the follicles are large, and numerous lymphoblasts are much more in evidence.

Adenoids. Moderately large. Only very slight atrophy of the lymphoid tissue as in the right tonsil.

4. R. C., aged eleven; 4 treatments; operation 450 days later.

Patient had had her tonsils partially removed previously.

Both Tonsils. Complete atrophy of the lymphoid tissue.

Adenoids. Markedly enlarged. No evidence of atrophy.

5. E. T., aged sixteen (not in this series); 8 treatments; operation 178 days later.

Left Tonsil. There is definite atrophy of the lymphoid tissue with a marked increase of fibrous tissue. Crypts open and draining and epithelium is everywhere intact.

Right Tonsil. Amount of atrophy similar to the left tonsil. However, there are several crypts which contain large masses of cellular debris where the crypt epithelium is ulcerated and replaced by granulation tissue. This indicates a rather marked chronic inflammatory reaction.

Adenoids. Follicles small and few in number. Epithelium normal.

6. R. W., aged nineteen; 4 treatments; operation 27 days later.

Both tonsils and adenoids are markedly hypertrophied and are hyperplastic in type resembling those of a child. Roentgen irradiation has had no appreciable effect.

7. C. W., aged thirty-nine (not in this series); 11 treatments; operation 80 days later.

Right Tonsil. Tonsil small and fibrotic with large trabeculae; follicles are small and few. However, one crypt is ulcerated at its orifice. Another contains a large cellular plug consisting mostly of leucocytes.

Left Tonsil. Much larger than right. No definite atrophy. Would correspond in size and number to the "standard" tonsil. All the crypts contain large areas of keratinized epithelium infiltrated with leucocytes.

Adenoids. No sections.

8. C. S., aged fifty-six (not in this series); 9 treatments; operation 163 days later.

Right Tonsil. Very marked atrophy of lymphoid tissue. However, there is marked infection of the crypts. One crypt has a large ulceration of the epithelium and another contains material with "actimomycosis-like" granules.

Left Tonsil. Atrophy more marked than on the right side. There are areas where the follicles have completely lost their shape and much of the lymphoid tissue is replaced by fibrous tissue. The follicles in the rest of the tonsil contain very few lymphoblasts.

Adenoids. No sections.

9. H. W., aged thirty-six; 9 treatments; operation 163 days later.

Both Tonsils. Showed marked atrophy of the lymphoid tissue. Crypts appear normal and there is no evidence of inflammatory reaction. Definite tubercles found in the right tonsil.

DISCUSSION

The present study has brought out several facts. There appeared definite shrinkage of the tonsils in those patients who had had a full course of treatment. They were free from colds and sore throats and felt better generally. The latter we felt might be due to the stimulatory action of the roentgen ray, but this effect persisted over eighteen months. The tonsils and adenoids of these patients after eighteen months did not appear any different from those in children not treated but the patients remained free from colds and sore throats, and difficulty in breathing. There was no effect on any condition supposedly secondary to infection in the tonsils.

It has been stated that roentgen treatment sterilizes the tonsils by improving the drainage of the crypts. Our previous observations tended to confirm this, but we felt at the time that our studies were incomplete. The recent bacteriological studies of Bloomfield would throw doubt on the accuracy of our observations except for one point—the presence or absence of beta hemolytic streptococci, and that is the essential point in this particular problem. Cultures taken four months and nine months after treatment showed the persistence of beta hemolytic streptococci in every case but one. From this it can be definitely stated that roentgen treatment has no effect on the pathogenic bacteria of the tonsillar crypts.

The pathological study helps to explain several factors. Case B. S. had a complete series of eight treatments and yet her colds and sore throats persisted after an initial period of improvement covering four months. Microscopic sections showed definite atrophy of the left tonsil with only slight atrophy of the right tonsil and adenoids. Eight treatments were purely an arbitrary number. In most of the patients it was sufficient, but it is to be expected that there will be some in

whom further treatment will be necessary. In cases D. N. and R. W. four treatments had no effect. Case L. B. while having only five treatments showed a definite atrophy of the lymphoid tissue. Operation was performed in this patient at the time of excision of a large fluctuant tuberculous gland. Case H. W. had nine treatments and showed marked atrophy of the lymphoid tissue of both tonsils. The presence of tubercles in the right tonsil readily explains the persistence of symptoms as the roentgen ray has no specific effect on tuberculous tissue. Case R. C. had an associated pyelitis. She had had severe colds and sore throats with marked hoarseness. She had had a previous tonsillectomy. The remaining tonsillar tissue disappeared under four treatments and the patient was free of colds for four months, after which they returned in marked severity. Sections showed complete atrophy of lymphoid tissue of the tonsils but no effect on the adenoids. In order for the treatment to be effectual it will be necessary to irradiate the adenoid region also and this was not done in the present series. Cases E. T., G. W., and C. S., all had sufficient roentgen treatment to cause a definite atrophy of the lymphoid tissue of the tonsils. However, there were evidences of local sepsis in the tonsils. Sections showed ulceration of the crypt epithelium with cellular infiltration, occlusion of the crypts by cellular debris and bacteria, keratinization of the epithelium, etc. This would show that roentgen irradiation has no effect on the inflammatory reaction in the tonsil though it does have an effect on the lymphoid elements.

SUMMARY

Clinical and pathological studies show that roentgen-ray treatment when given in sufficient doses causes a definite shrinkage of the lymphoid tissue of the tonsils and to a less extent of the adenoids (as they were not irradiated directly). Bacteriological and pathological studies show that roentgen-ray treatment has no effect on local sepsis in the tonsils and adenoids. These two facts would clearly outline the type of patient where roentgen treatment would be beneficial.

Many children have frequent colds and sore throats and difficulty in breathing as a result of the hypertrophy (hyperplasia) of the tonsils and adenoids. Many of these children outgrow their symptoms at puberty. The wholesale subjection of these children to operation has little to commend it. Roentgen irradiation offers the ideal treatment as it provides a means of shrinking the lymphoid tissue without the disadvantages of an operation, as our results of only one failure in nine cases would show. On the other hand, where there is evidence of local sepsis in the tonsils or adenoids, roentgen treatment does not help, and operation is clearly indicated. Local sepsis can readily be determined from the history of acute tonsillitis, suppurative otitis media, tuberculous cervical adenitis, infectious arthritis, diphtheria carriers, etc., along with the signs of infection in the tonsil other than simple hypertrophy.

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ROENTGEN DIAGNOSIS OF NON-OPAQUE FOREIGN BODIES IN THE TRACHEA*

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IN a former paper on the subject,[1] "The Roentgen-Ray Diagnosis of Non-Opaque Foreign Bodies in the Air Passages," read at the Twenty-Second Annual Meeting of the American Roentgen Ray Society, Washington, D. C., September, 1921, we dwelt briefly on the roentgen-ray diagnosis of tracheal foreign bodies. We bring this paper to reiterate an important matter; to emphasize our confidence in the value of the study; to demonstrate a method of marking the films so as to be able to differentiate between films of inspiration and those of expiration, and at the same time to prove the presence of obstructive emphysema of both lungs; and especially to emphasize that a considerable percentage of this type of foreign body found in the trachea at the time of operation have been in one or other of the bronchi during their sojourn in the air passages, and that the roentgen diagnosis of foreign body in a bronchus is not to be considered an error, if at operation it is found in the trachea.

There are a number of facts that make this matter important: (1) aspiration of foreign bodies of various kinds is an accident that does occur with great frequency in children, and occasionally in adults; (2) only a very small percentage of such foreign bodies are expelled spontaneously. Jackson states that about 2 per cent are so expelled; (3) any foreign body in the trachea or in a bronchus that is neither expelled nor removed will cause lung abscess sooner or later and materially shorten life, or cause early death; (4) the non-opaque foreign body, which usually means vegetal or organic substance, is, as a rule, very irritating, produces early inflammation and relatively early infection, with its attendant high mortality or invalidism; (5) the diagnosis of non-opaque foreign body in the trachea or bronchi by means of the roentgen ray is almost always possible at the first examination, and we believe that with repeated examinations in doubtful cases the diagnosis can be made in all cases when the foreign body is in a bronchus, and in nearly all of the tracheal foreign bodies. The value of repeated examinations lies in the fact that the foreign body that does not produce signs at the first examination is one that is not lodged, but free to move from place to place. The roentgen-ray signs vary with change in position of the foreign body, and sooner or later one has a collection of films that when one set is compared with others some variation in the function of the lungs will be noted, or the diaphragm or heart relations will be altered or some exudate will appear, or, if the foreign body does not move the local reaction varies, and signs relative to a given location become more pronounced, so that a positive diagnosis may be made by showing these variations without there having been at any time striking signs; (6) it seems evident from continued and repeated experience in Dr. Jackson's clinic that the general practitioner has difficulty in making the diagnosis, makes a wrong diagnosis, or does not look upon the condition as being serious, clinging to that erroneous hope that the child will cough up the foreign body. As a matter of fact, the clinical diagnosis is not easy for one who has not seen many proven cases, and unless there is a definite history of aspiration the general practitioner may not even consider such a possibility. We recently had a case in which a child had a coughing attack while eating a cracker. Naturally anyone would believe that a fragment of cracker would actually dissolve and come away in liquid form, yet this child kept on coughing. A wise physician sent the child to Dr. Jackson. The roentgen-ray signs of non-opaque foreign body in one bronchus were positive, and Dr. Jackson removed, not a piece of cracker, but a piece of peanut kernel. No one knew when the child got the peanut. We are

[1] AM. J. ROENTGENOL., 1922, IX, 288–303.

* Read at the Sixth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 22–24, 1925.

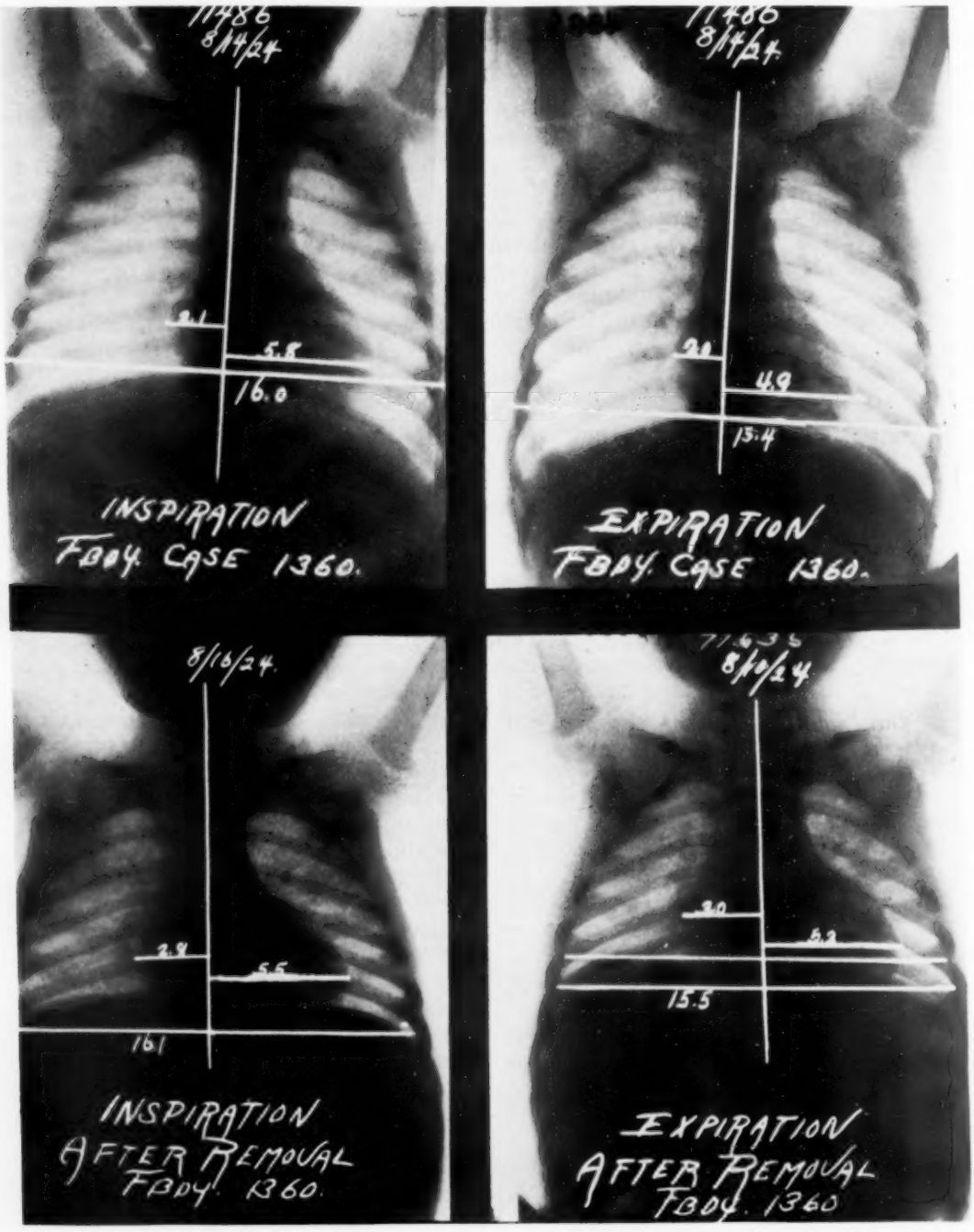

FIG. 1. Positive signs of obstructive emphysema of both lungs. Note that transverse diameter of heart and of chest is shorter at expiration than at inspiration before removal of foreign body. Also note difference in diaphragmatic level before removal as compared with that after removal of the foreign body.

convinced that many other children have such accidents unobserved, and that many of them die as a result, with a diagnosis of pneumonia, bronchopneumonia, asthma, enlarged thymus or some other thing. It is clear that it is the duty of every roentgenologist to acquaint himself with the signs that do make for positive diagnosis of non-opaque foreign body and have them in mind when studying the chest for any lesion.

Our confidence in the roentgen-ray signs increases daily and especially we are coming to feel much more confidence than we had formerly in our findings in cases of tracheal foreign body.

From a pathologic point of view, the non-opaque organic foreign body causes one or more of four changes in the lung distal to it when it is lodged in a bronchus or one of its branches. These changes are: (1) obstructive emphysema; (2) atelectasis; (3) drowned lung; and (4) abscess. When this kind of foreign body is in the trachea, the roentgen-ray signs are limited largely to those of obstructive emphysema of both lungs. A tracheal foreign body to cause atelectasis must produce complete obstruction to inspiration, and this in turn would be rapidly fatal. One can conceive of the accident occurring, but not that the end would be postponed sufficiently long for the roentgenologist to observe the results. Drowned lung is not a common, or in itself a dependable sign of tracheal foreign body, but we have seen it present in a few cases. Lung abscess is more a terminal process, and while it may occur as a result of a tracheal foreign body, we have had no evidence of it in any of the cases that we have seen.

Obstructive emphysema of both lungs is then the only real dependable sign to go on, although there are a number of recognizable variations from the normal appearance that help one to make a probable diagnosis or persist in the examination or repeat it until more positive signs are shown. The roentgen-ray signs of obstructive emphysema in one lung as the result of a bronchial foreign body are, as stated in a former paper:

"1. Increased transparency of the affected lung. 2. Depression and partial fixation of the diaphragm on the affected side. 3. Displacement of the heart and mediastinal structures away from the affected side. 4. Increased excursion of the diaphragm on the unaffected side, due to compensatory emphysema." It is most important to remember that all of these signs are determined by comparing the view of inspiration with that of expiration, and that the first three are most noticeable at the end of *expiration* (Figs. 4 and 5).

When the foreign body is in the trachea (Fig. 1), there is increased aeration of both lungs, both diaphragms are depressed, and the heart rotates, so that its apex comes forward, it appears to be more vertical, and its shadow is diminished in the transverse direction at expiration. The transverse diameter of the chest is also shorter at expiration than at inspiration. The signs pertaining to the diaphragm and heart are apparently due to the accessory muscles of respiration being more powerful than the diaphragm. The signs are striking or slight according to the degree of expiratory obstruction. They are difficult to recognize only when they are slight. The size and shape of the foreign body, and the degree of inflammatory reaction in the trachea are the mechanical factors that control the extent of obstructive emphysema (Fig. 2). It is obvious that the smaller the foreign body, the less obstruction it will produce, and also the less apt it is to stay at any particular point. It is our belief that any organic foreign body that becomes definitely lodged in any portion of the trachea, regardless of its shape, will produce either obstructive emphysema or death from inspiratory obstruction. We also believe that the vast majority of such foreign bodies that are free to move from place to place either move downward and produce positive signs in one or the other lung or move upward into contact with the glottis, where, regardless of size and shape, they produce positive obstructive emphysema of both lungs because of the spasm of the glottis. We have on more than one occasion noticed at the roentgenoscope that at one instant there was evidence of obstructive emphysema on one side, and at the next instant that lung was again functioning the same as the other.

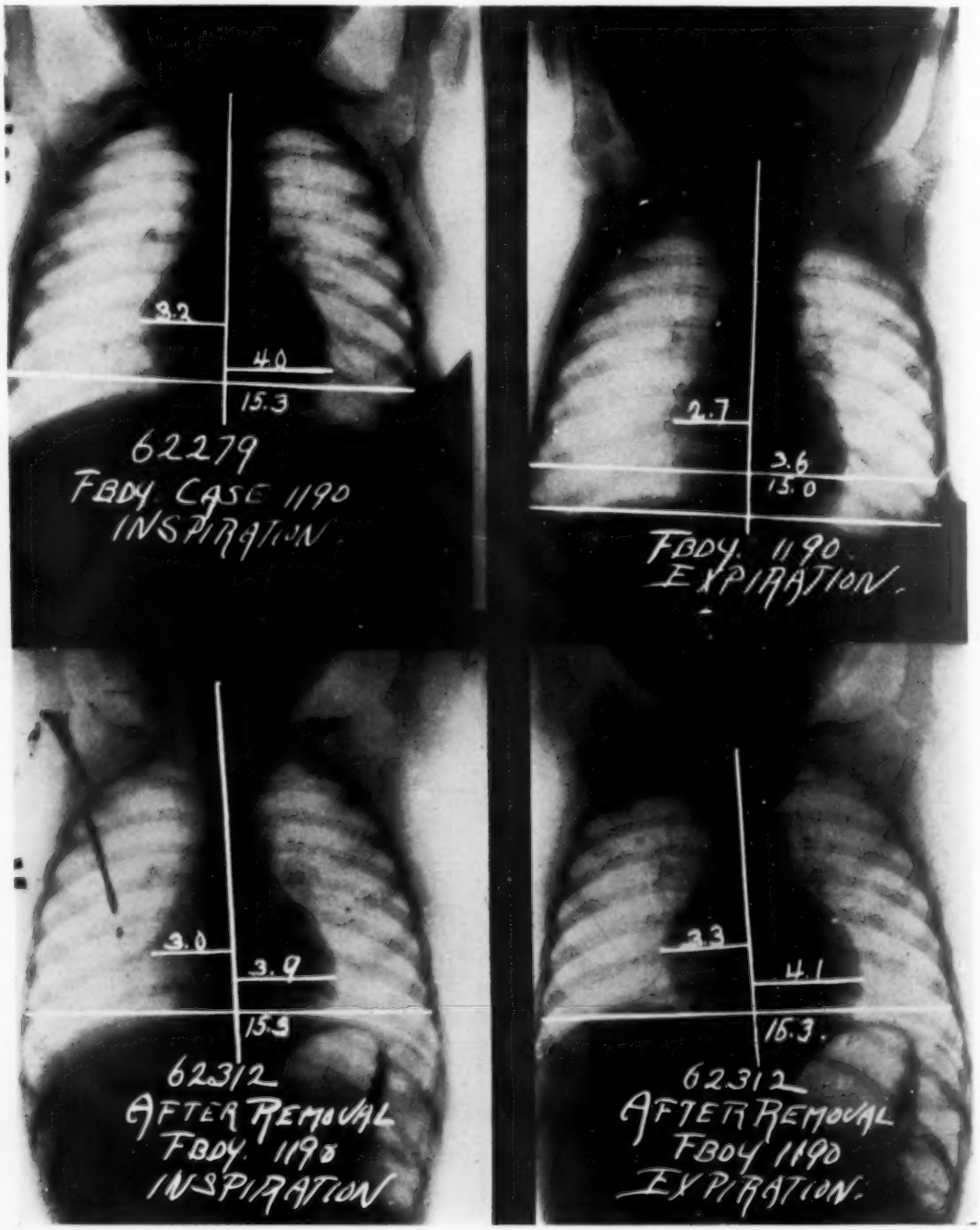

FIG. 2. Compare heart and chest diameters before removal and after removal. The narrow diameter of the chest is always expiration. The heart diameter varies, being shorter at expiration than at inspiration when obstructive emphysema is present, but as long or longer at expiration than at inspiration when there is no obstructive emphysema. Note that diaphragm is lower at expiration than at inspiration before removal of foreign body.

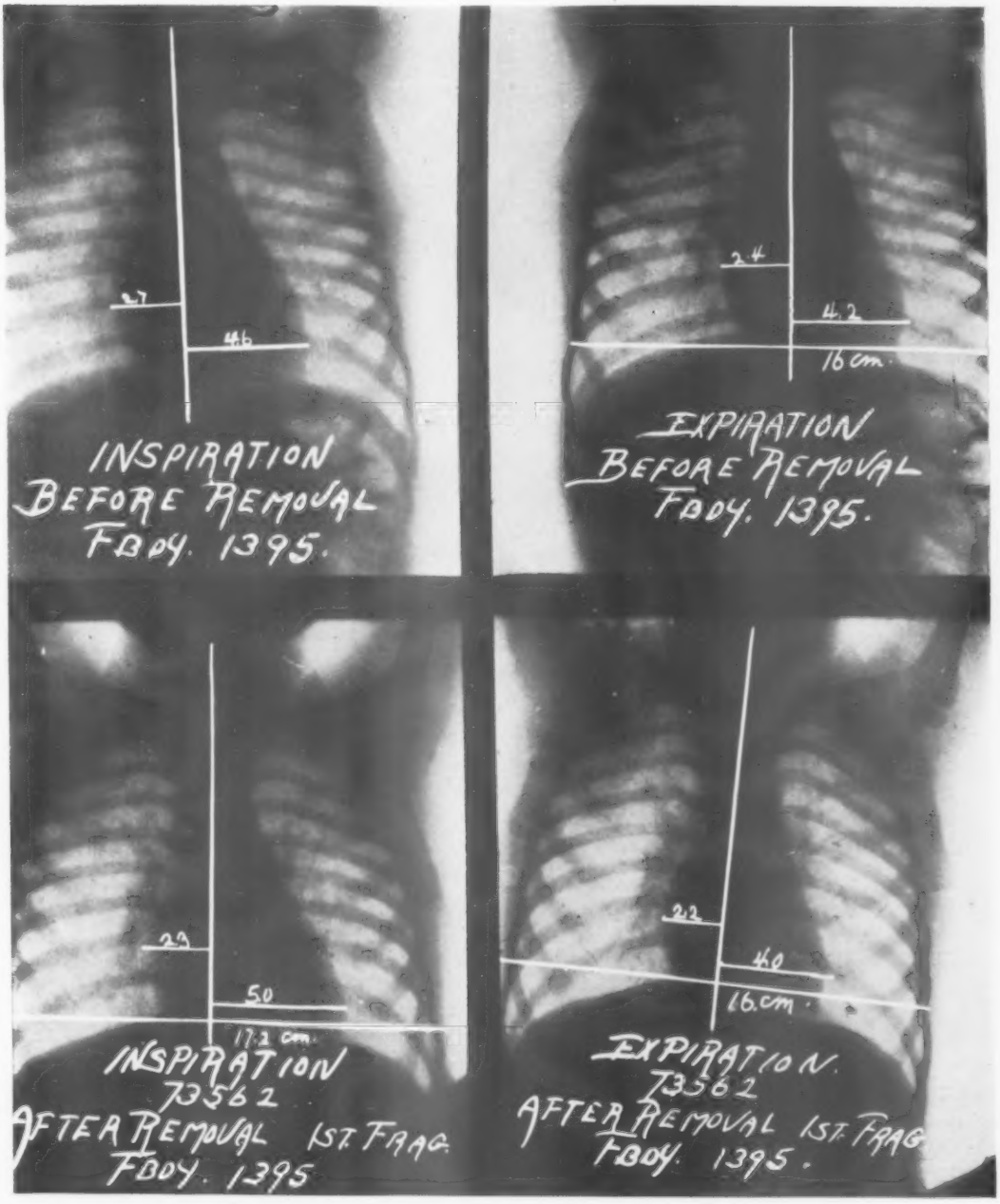

FIG. 3. In this case two foreign bodies were present. A careful study of measurements shows that there was a higher degree of obstructive emphysema after removal of the first fragment than before it was removed. A second piece of peanut kernel was then removed.

We have also repeatedly made the roentgenoscopic observation that there was evident restricted motion of both diaphragms when there was uncertainty as to the presence of obstructive emphysema. And we have been able to demonstrate positive signs of obstructive emphysema on films exposed at inspiration and expiration by making careful measurements of the transverse diameter of the heart and chest, when there was some doubt in our minds at the time of the roentgenoscopic study. In one instance we obtained positive signs of obstructive emphysema of both lungs after a tracheal foreign body had been removed (Fig. 3). At the roentgenoscopic study it was noted that the breathing difficulty was expiratory in character and that both diaphragms were restricted. The films made after this roentgenoscopic examination demonstrate a higher degree of obstructive emphysema of both lungs than was seen before removal of the first foreign body. A second foreign body was then removed from the trachea. This case proves not only that there may be more than one foreign body but also that the signs may vary from time to time with the same foreign body, as will be seen by comparing the films of inspiration and expiration made before removal of the first foreign body and those made just before removal of the second foreign body.

The measurements as will be noted in the illustrations are made as follows: A line is drawn through the center of the spine shadow from apex to diaphragm, a transverse line at right angles to this at the level of the vertebral end of the ninth or tenth ribs, and the usual lines of the heart shadow to indicate the transverse diameter of that organ. In the normal chest it will be found that the heart shadow has a greater transverse diameter and the chest has a shorter transverse diameter at the end of expiration; also, the heart diameter diminishes and the chest widens with inspiration. When there is expiratory difficulty or, in other words, obstructive emphysema of both lungs, then the transverse diameter of both the heart and chest will be less at the end of expiration than at the end of inspiration. It is necessary to be extremely careful in the technique of the exposures, but when the factors of distance and direction of the central ray through the body are carefully maintained, one can by such measurements determine whether an exposure, as compared with another, has been made at inspiration or more nearly at the end of expiration, because the transverse diameter is controlled by the intercostal muscles which necessarily contract at expiration. One might also draw lines from the apices to the dome of the diaphragm and get an accurate record of the change in the level of the diaphragm between inspiration and expiration. It is easily seen that when the obstruction is fairly marked, the diaphragm is much lower during expiration than during inspiration, in other words, there is a paradoxical diaphragm motion. Then when we compare the illustrations of inspiration and expiration before removal of the foreign body with the same phases after removal, we see there is usually a marked difference, and we can the better appreciate the over-distention before removal.

The breathing cycle is consciously or unconsciously—yes, we believe intentionally—restricted. This is probably because deep breathing causes the foreign body to move and be forced upward perhaps against the glottis where it will cause a violent paroxysm of coughing and expiratory difficulty, or the obstruction is enough to cause air hunger and the child realizes that the more it struggles, the more air it needs. In fact, at times what appears to be dyspnea is nothing more than this cautious, shallow, apprehensive sort of breathing because the child soon learns the wisdom of it. We consider it a strongly suggestive sign of tracheal foreign body when such careful breathing or apparent dyspnea is present and there is no roentgen-ray evidence of a pathologic process in the chest, such as pneumonia, pleural effusion, mediastinal tumor, thymus, cardiac lesion, or lesion of the larynx.

The most common non-opaque tracheal foreign body is the watermelon seed; next comes the grain of corn, then the peanut kernel, and also a few others. The watermelon seed, because of its shape and size, is apt to stay in the trachea and is fre-

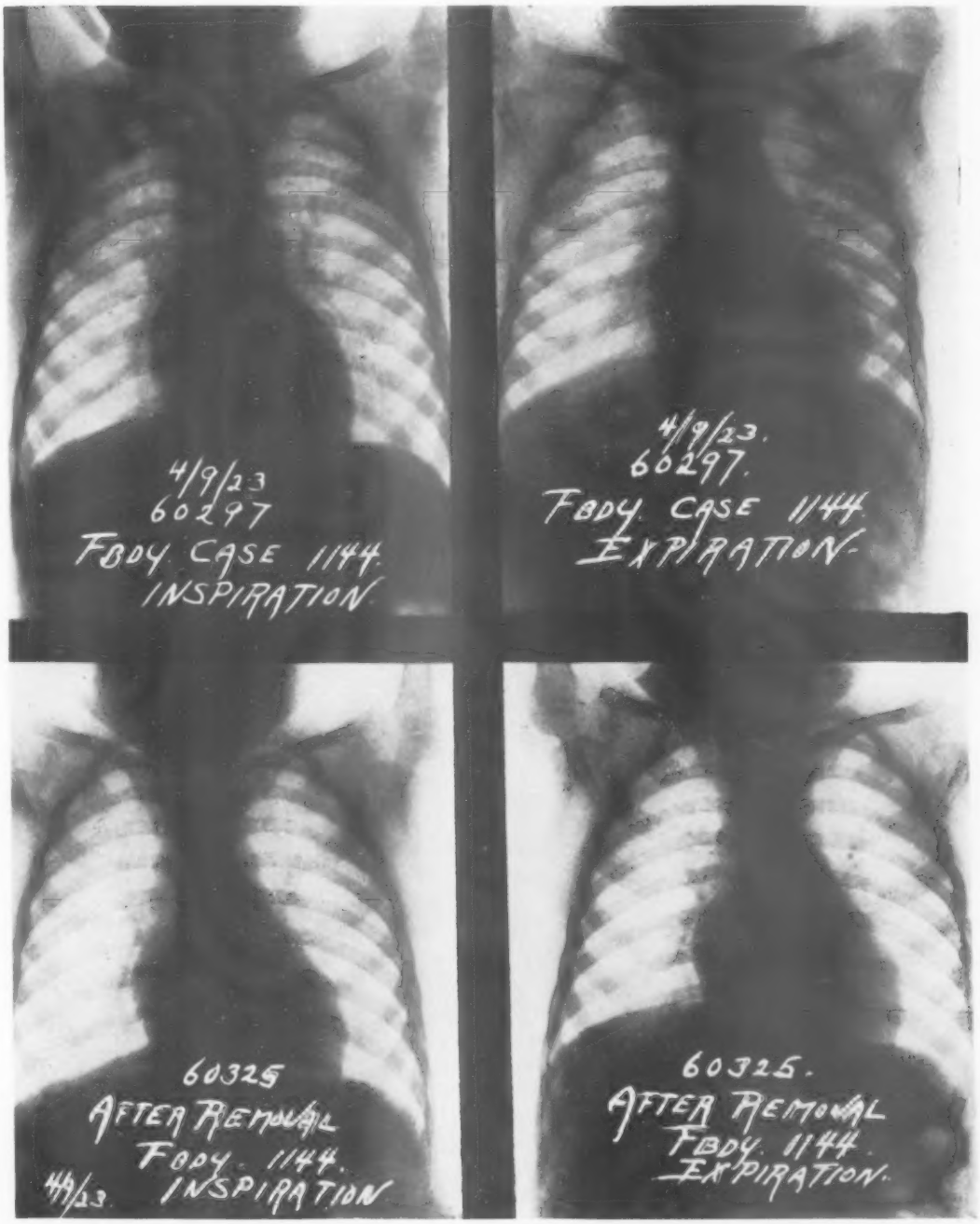

FIG. 4. Positive signs of obstructive emphysema of the right lung. Foreign body was in right bronchus at time of roentgen examination, but was removed from the trachea.

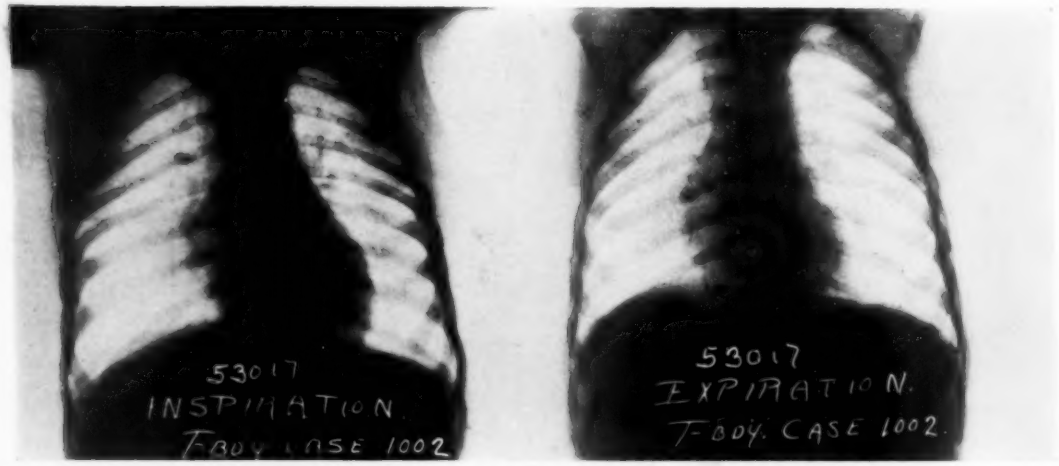

FIG. 5. Positive signs of obstructive emphysema of left lung. Foreign body in left bronchus at time of roentgen examination, but removed from the trachea. No films made after removal.

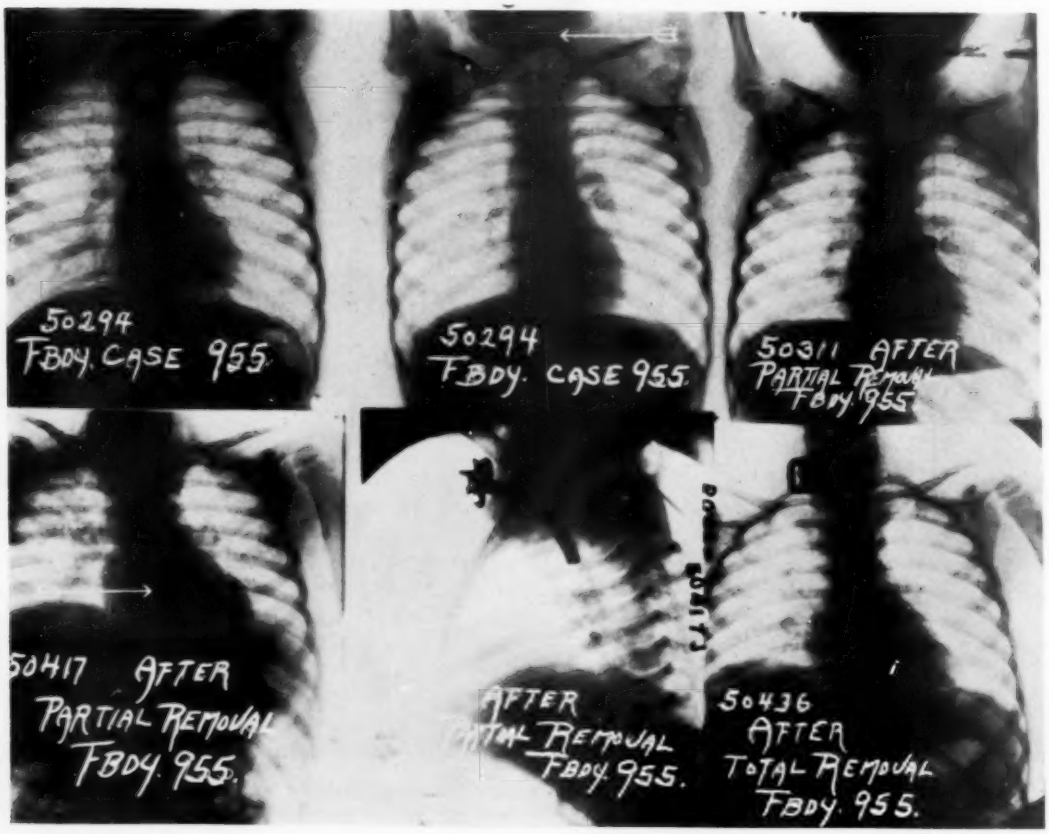

FIG. 6. See description in text.

quently fairly freely movable, but repeatedly we have seen it produce obstructive emphysema of one lung, and we have also seen it produce striking obstructive emphysema of both lungs when lodged in the trachea, and we believe that with careful and repeated studies we can sooner or later make positive diagnoses in practically all of them.

The tracheal foreign body that is too small to produce recognizable obstructive emphysema usually gives the most positive physical signs, or lodges in a bronchus—in fact, one of the most dependable findings in physical diagnosis is that the signs vary from day to day or hour to hour.

We feel that it is extremely important to establish the fact that a number of the foreign bodies that have been removed from the trachea have previously been lodged in a bronchus, and that a unilateral obstructive emphysema is diagnostic of expiratory obstruction of a bronchus, not the trachea (Figs. 4 and 5). It is probable, of course, that if more than one foreign body were present, a fragment in each bronchus would produce obstructive emphysema on both sides, but probably not to the same degree. It is not possible for us to determine whether the shifting foreign body changes its position before operation or at the time the bronchoscope is inserted, but we believe that both do occur.

In one case, the foreign body being a piece of wax crayon, we saw these changes take place under the roentgenoscope and at the same time saw the shadow of the foreign body. We were able also to get films of these various conditions (Fig. 6). When we first saw the child, the foreign body was in the right main bronchus and we saw clearly the presence of obstructive emphysema of the right lung. Then the foreign body suddenly rushed upward to the under surface of the glottis. Immediately there was a strangling attack and both lungs at one instant were greatly over-distended; then we sat the child up and gave it a slap on the back, when the foreign body went down again to the right bronchus. Then we transferred the child to the roentgenographic table and made a film at inspiration. Just as we were ready to make the exposure at expiration, the child again began to strangle, and we obtained an exposure showing the foreign body at the under surface of the glottis. Again the child was slapped and the foreign body went to a bronchus. At the bronchoscopic operation, Dr. Jackson found the foreign body very fragile, and it broke, so that he only removed a portion of it. The remaining portion then went into the left bronchus, where it produced obstructive emphysema of the left lung. This, of course, is not an organic foreign body but it serves so well to illustrate the fact of the shifting foreign body.

A few insistent words as to technique of examination. At the roentgenoscope one must be sure that the child is lying flat on the back, not turned to one side, and the head must be facing directly upward so that the chin is in line with the sternum. The arms should be held above the head. When a foreign body is in the trachea, the diaphragm motion will either be limited or paradoxical. The heart will rotate, and because of this look smaller at expiration than at inspiration. One should continue the study for a matter of minutes if the signs are not immediately positive. They may change during the observation, or evidence at first not noticeable may become apparent.

To make roentgenographic studies, one must make the exposures so rapidly that even breathing motion will not blur the film. We try to accomplish this in from $\frac{1}{30}$ to $\frac{1}{15}$ of a second. Intensifying screens should be used. Slight under-exposure is better than over-exposure, and a moderately short spark gap better than a long spark gap. A rapidly acting time switch is essential not only to obtain short exposures, but also that exposures may be exactly alike. The position of the patient is the same as in roentgenoscopic study, and we like the tube to be at least 36 inches from the plate. The exposures are made anteroposteriorly, always through the median line, always at exactly the same distance, and as nearly as possible the same film, tube and patient relations.

The writer is deeply indebted to Dr. Chevalier Jackson for permitting the use of this material from the Bronchoscopic Clinic at the Jefferson Hospital.

CHRONIC APPENDICITIS

BY A. G. SCHNACK, A.M., M.D.

HONOLULU, T. H.

A great deal of experimental work has been done to establish explanations for normal and pathological bowel motility. The "gradient" hypothesis of Alvarez[1] opens up a new and interesting viewpoint in explaining many of our so-called "reflex" actions. The term "reflex" may have been overworked in the past but we still find it useful in explaining certain phenomena, when we find, for example, one organ producing an effect on a remote organ without any possible connection between these organs other than their extrinsic nerve supply. We should like to use the term "reflex" in a loose sense to explain phenomena seen at a distance from the source of irritation or stimulation. Those who demand laboratory or experimental proof for our conclusions will be disappointed, as pathological conditions that take years to produce and are not thoroughly understood cannot be simulated in the animal laboratory. We know, for instance, that the appendix under normal conditions must empty itself periodically through a peristaltic contraction wave. We have not been able to produce such a wave experimentally. We are forced to apply a reasonable explanation of events, and proof can only be admitted by the great frequency of similar findings under similar conditions. The roentgen ray has recently stimulated considerable interest in large bowel conditions and their effect on the small bowel and stomach and perhaps the entire system. A great deal of this must be considered in the differential diagnosis of chronic appendicitis, and from the point of view of a primary source of appendix disease.

Many of the large clinics seem to be content in most cases with a single day roentgen examination of the gastrointestinal tract. Resorting to enemas for conditions of the large bowel does away with the opportunity for studying normal large bowel motility and in great measure the effect of local irritative conditions. The barium clysma can better be used for contributory evidence. Those of us who have religiously roentgenoscoped and palpated our abdominal cases at six, twenty-four, forty-eight, and frequently seventy-two hours, feel that we can often give the attending physician information concerning conditions that is of great importance even though it be of a non-surgical nature. Where there is no definite history of constipation we have avoided cathartics, and when cathartics were deemed necessary these were given forty-eight hours before the examination to avoid changes due to cathartic irritation. We shall not concern ourselves with the theories of normal rhythmic motility, peristalsis, antiperistalsis, and modes of advance and absorption of materials from the large bowel, except to remember these in an accepted way.

It is a well-known fact that the end-results after appendectomy for so-called "chronic appendicitis" are not very gratifying. Only a small percentage of cases (some place this as low as 10 per cent) are free from the original symptoms after the benefits of rest in bed, diet, etc., following operation, have worn off. It is natural that we attempt to fathom the reason for this. Many pathologists insist that the average chronic appendix is generally only a part of a pathological condition involving the proximal colon also, and so it becomes important to differentiate between types of chronic appendix. This we think we can in most cases do with the aid of the roentgen ray.

We wish to define a chronic appendix as an appendix which is producing symptoms of distress to a greater or lesser degree over a considerable period of time. These symptoms may be local or remote from the source of irritation. We know that any irritation of practically any organ in the body will "reflexly" excite changes from the normal in the mechanics of the gastrointestinal tract. Organs such as the liver, gall-bladder, and pancreas, embryonal out-pouchings from the gut, more easily perhaps produce gastrointestinal variations. It seems, in great measure, a

question of identity of nerve supply. With regard to the gastrointestinal tract proper, irritation at any point produces manifestations of a greater or lesser degree in every other section of the tract. The "reflex" signs associated with appendiceal irritation are not peculiar to this condition alone, but when combined with local signs and subjective symptoms, and by a process of elimination, we can generally arrive at the correct diagnosis. We shall in our differential diagnosis consider only the gastrointestinal tract, assuming that other causes for the symptoms have been eliminated.

Our definition of a chronic appendix does not limit us to the inflammatory type, but it does require that the appendix must be a definite source of irritation capable of giving subjective, reflex, and local signs and symptoms. The gross pathology of a chronically irritated appendix may show a mere vascular congestion with a little tissue edema, or we may find nodular thickenings due to sclerotic scars from previous local ulcers and infections, or we may find denudation of the mucous membrane, with perhaps scars obliterating the lumen at one or more points. A bulbous tip retaining sterile mucus and debris may result. The formation of external adhesions from perforations or serosa involvement is common. The microscopic sections may show in addition in many cases evidences of scar formation and epithelial denudation, an eosinophilic invasion of the lymphoid gland cells and lymphocytic infiltration of the submucous stroma, and possibly an occasional polymorphonuclear neutrophile. These findings may result from mere stasis or fecaliths. Some of the strictly appendiceal sources of irritation are fecaliths, foreign bodies, kinks, fixation, constriction, obstruction and inflammation. These have to be differentiated from primary abnormal conditions in the proximal colon, resulting in secondary appendiceal changes. Generally speaking, the first group of conditions alone can be easily differentiated, but we may have the second group confusing the picture as well.

The very common finding of tenderness when palpating the right lower quadrant, unless associated with local signs and definite subjective symptoms, has very little significance in considering appendiceal pathology. A bubble of gas in the appendix or cecum or a slight distention from constipation will give considerable tenderness when palpating this region. We believe that an appendix that does not produce the usual "reflex" roentgen findings has very little to recommend it as a source of danger. These findings, briefly mentioned, are generally pylorospasm, duodeno-bulbar spasm, erratic and marked degrees of reverse peristalsis in the small bowel, a tendency to a delay in stomach emptying, ileal delay, and often a definite degree of spasticity of the transverse and descending colon. Most of these findings are usually present. To these "reflex" findings we add the local signs of a tender appendix, often with pain radiating to different parts of the abdomen when palpating the appendix, marked irregularities in contour, definite kinks, bulbous appendix tip, local dilatation of the appendix, fixation, evidence of adhesions to neighboring organs such as the duodenum, cecum, etc. The history and subjective symptoms must also be considered. Because of the affect of appendiceal irritation on the remainder of the bowel we find frequent "spells of indigestion" after indiscretions in diet. These are often erroneously spoken of as attacks of appendicitis, which some of them may be, but an impaired gastric function will not allow dietary indiscretions. The irritation from fecaliths and foreign bodies such as fruit seeds, pin worms, etc., may be quite marked and is a rather frequent finding. Kinks and fixation secondary to appendiceal inflammation or due to improper development are a frequent source of trouble. In the embryonal growth of the bowel we have elongation, descent, rotation, fusion of mesentery, etc. Inclusion of the appendix in the retrocecal space militates against free mobility and natural motility of the appendix, as does a short mesentery. A too free and long appendix may tend to pathological torsion, just as rotation of a too mobile cecum may result in cecal obstruction and even gangrene. Fusion of the appendix to neigh-

boring organs or the abdominal wall during the descent of the cecum may produce kinking of the appendix and cecum. A constriction about any portion of the appendix may result from external adhesions or a sclerosing appendiceal inflammatory process.

The frequent finding of a dense line of barium surrounding a more radiolucent middle portion of the appendix practically proves the same method of filling as we find in the colon.[2] Here we find a dilatation of the colon with the circumferential advance of liquid material about the hardened or inspissated core. This explains the apparent filling with the barium mixture of an appendix which shows a forty-eight or seventy-two hour stasis. Examined from day to day an appendix which shows a residue will seem to shrink in thickness as the barium is compressed more and more. If there is a cecal stasis the continued influx of barium prevents this apparent shrinkage. Most appendices can be demonstrated at the twenty-four hour examination. If the appendix cannot be demonstrated, it may be retrocecal, hidden behind the cecal contents, or it may be occluded by constrictions, kinks, outside pressure or traction, or fecal contents, and its condition must be judged in great measure by the reflex effects on the remainder of the gastrointestinal tract. The inflammatory appendix can often be palpated as a considerably thickened and often nodular tender organ. Appendiceal stasis in itself should not be given much importance but it does allow us better to locate the appendix and to determine tenderness, fixation, etc. Examining such an appendix over several days makes one more certain of true local conditions. Appendiceal stasis is however a potential source of future trouble, which may develop very slowly, or by periodic exacerbations. An appendiceal inflammatory condition may be appendiceal only, or it may be a direct extension from a cecal inflammatory process or it may be secondary to cecal stasis. With cecal stasis we generally have a still greater tendency to appendiceal stasis with resulting appendiceal irritation, although stasis may exist over long periods without much evidence of irritation. It may be pretty definitely stated however that an appendix which fills and empties within the forty-eight hour period cannot be pathological, unless we include slight congestive states as pathological.

We often have the greatest difficulty in differentiating the findings due to proximal colon conditions and, unfortunately, this combination of conditions is a very frequent one. There is a tendency for the surgeon to ascribe symptoms to an appendix which have their origin for the most part in the large bowel. A chronic cecal constipation will give practically all the local and reflex signs of a pure case of appendiceal irritation. Catharsis in such cases often gives complete symptomatic relief over a considerable period of time. Generally speaking, when there is a definite degree of appendiceal irritation, we find the stimulation sufficient to produce, except for perhaps a very slight cecal residue, a definite increase in the rapidity of proximal colon emptying; in other words, no great degree of "right-sided" constipation. When the appendix is merely part and parcel of a low-grade irritative colonic constipation, we do not find the rapid proximal colon emptying. In such cases, unless we find evidences of adhesions, appendiceal constrictions, kinks, a tender appendix, etc., it is better to think of the colon as being the main cause of the symptoms. These cases, as mentioned above, are often temporarily relieved by proper catharsis. Saline cathartics, we may say, often do not give relief because we merely get the usual circumferential advance of liquid cathartic about the central inspissated core without a real stimulation of the intestinal peristalsis. Very frequently in cases of true appendiceal irritation we find a certain amount of cecal stasis. The residual barium is however very small but persistent. The significance of this is not easily explained, but is in some way associated with a local loss of bowel tone.

Some surgeons have recommended plicating the cecum or obliterating it entirely by invagination to help remove the possibility of local stagnation. The cecal conditions which may give rise to bowel

disturbances resembling those due to irritative appendix are quite numerous. We may find a local stagnation resulting in the formation of fecaliths of stony hardness, and perhaps local cecal ulceration. There may be extreme dilatation and reduction of the cecal wall to a tissue-paper thickness. Intestinal stagnation may be limited to the cecum or it may extend though the entire length of the large bowel. The size of the large bowel is not necessarily an index of the intracolonic tension. We may state, according to Mills,[2] that the intracolonic tension is probably equalized throughout the large bowel by the rapid peripheral advance of the liquid contents from the small bowel. Judging from the extreme dilatation possible under gaseous distention, as we find it in intestinal obstruction, we would think that the ordinary bowel enlargements speak more for loss of tone. We would expect rather to find an increase in intracolonic tension with evidence of a spastic bowel condition. We may find a dilated cecum with spasticity of the remainder of the large bowel probably indicating an increased tension. The size of the appendix, we do not believe, should be considered an index of intracolonic tension. The entire colon may show tenderness to palpation and the cecum and appendix may show irritation of no greater degree. Cecal stagnation could naturally be a possible source of more grave appendiceal pathology, but unless the appendix does show definite evidence of disease, we should lean towards constipation as a diagnosis. A mobile appendix that has a wide outlet into the cecum and does not show other evidence of a pathological condition, when associated with constipation, should not be considered a primary source of irritation. Ptotics, as a class seem to be constipated. Redundancy of any portion of the colon or cecum seems frequently to favor cecal and general stasis. Disease of any organ may indirectly affect the bowel, and lead to stasis. Constipation of the recto-sigmoid from improper habits, hemorrhoids, anal fissures, irritation from seatworms and other causes, anal infections and sinuses, pressure from tumors or neighboring organs, adhesions, etc., should all be considered causes for general and cecal constipation.

The treatment, in most cases, consists in building up the colonic tone by proper exercise, rest, posture correction, stimulating food materials, removal of gas-producing foods, etc. Abdominal massage and abdominal muscle exercises, and attempts at regular bowel movements, often aid. Unless cecal stasis can be remedied we constantly have the possibility of graver appendiceal symptoms developing, but until we do find direct evidence of more definite appendiceal irritation the treatment should be for constipation rather than by appendectomy. With the improvement in the cecal stasis the so-called appendiceal signs often disappear.

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A CASE REPORT OF MULTIPLE MYELOMA

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MULTIPLE myeloma of the bone is a sufficiently rare tumor, and the difficulty of diagnosis from the roentgen standpoint makes the following case report of value. Another unusual feature of this case is the very long history of duration of the disease.

Myeloma was first described by Macintyre[1] in 1850, under the term "mollities ossium." He reported the presence of albumose in the urine. Rusticky[2] in 1875 gave this disease the name of "myeloma." Kahler[3] in 1883 gave the complete description of the condition and reported the presence of albumose in the urine as a constant diagnostic feature.

FIG. 1. Lateral view of the skull showing the extensive destruction of the bone by multiple myelomata.

The disease is characterized by multiple lymphocytic, myelocytic or plasma cell invasion of the bone marrow throughout the body. This leads to the destruction of the bones. It is closely related to sarcoma, except for its wide distribution and the fact that the lesions are always multiple. Metastases as a rule do not occur in the other organs of the body. Myeloma is a malignant tumor, rare of occurrence and slow growing. Its favorite site is in the flat bones. The long bones may be involved but this, as a rule, is a later feature of the disease.

Baetjer and Waters[4] describe the condition "as exceedingly rare and difficult, if not impossible, of diagnosis from the X-ray standpoint alone."

The diagnostic points although not entirely reliable may be grouped as follows: The lesions are multiple and the bones are pierced by small focal spots of destruction which are not confluent. The tumor does not expand nor destroy the cortex. There is a marked rarefaction of bone which may cause a thinning of the cortex. Pathological fractures are common. Bence-Jones bodies in the urine with the atypical roentgen findings generally lead to a correct diagnosis. Roentgen therapy has been tried in these cases and although it is not curative and probably does not even arrest the course of the disease, nevertheless the pain has been very strikingly relieved, as was the case with this patient, and for that reason alone its use is desirable.

FIG. 2. Shows the involvement of the cervical spine, clavicles and ribs.

This patient entered the hospital in December, 1922, and has been readmitted a number of times. Her last admission was March 22, 1924 and she has been here ever since. Her general condition is fair, although she has progressive secondary anemia. She is able to feed herself and read while confined in bed. Pathological fractures are constantly occurring but these seem to unite quite rapidly and well (Figs. 1, 2, 3, 4, 5 and 6).

2,600,000, hemoglobin 60 per cent, white cells normal. Urea nitrogen 5 mgm. per 100 c.c. Wassermann reaction negative. Roentgen examination showed practically all bones invaded by multiple myeloma.

Second admission from February 27, 1923 to March 21, 1923. She entered the hospital this time for roentgen treatments. Hemoglobin 74 per cent, red cells 3,180,000.

Third admission from May 29 to May 31, 1923. No change in condition. Urine

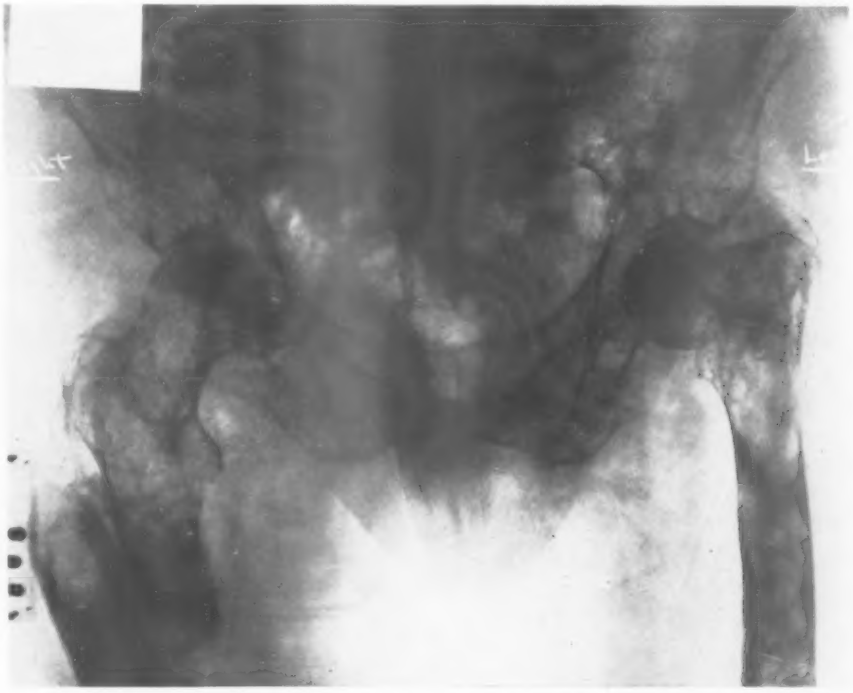

FIG. 3. Shows the extensive destruction of the bones of the pelvis and both femurs. Pathological fracture of the right and evidence of repair by callus.

CASE REPORT

German woman, aged fifty-eight, entered the hospital December 5, 1922, and left January 11, 1923. Diagnosis, multiple myeloma of bones. Five months previously she had felt a sudden pain while lifting. It was noticed in the right hip and disappeared in two weeks. Then she had a pain in the left hip which has remained constantly since but is relieved by lying down. The pain caused her to bend backwards while walking. Physical examination was negative. Blood count showed a marked secondary anemia. Red cells showed Bence-Jones protein in lesser amounts than formerly. Hemoglobin 62 per cent, red cells 2,800,000.

Present and fourth admission, March 22, 1924. After discharge she did well until three months ago when she fell and fractured the left femur (Fig. 7). Upon admission pathological fracture of the opposite femur was also found (Fig. 8). She does not know what caused it. Physical examination showed loss of all mobility at right hip and but slight mobility at left hip. There is a fair amount of motion below both knees and some apparent shortening of the right leg. Left thigh shows some bony irregular-

FIG. 4. Shows the lesions in the radius and ulna which demonstrate the fact that the lesion consists of small focal spots of destruction which are not confluent and do not expand nor destroy the cortex.

FIG. 5. A good demonstration of the lesion in the right humerus and radius. Again demonstrates that the cortex of the bone is not expanded nor destroyed.

FIG. 6. Shows the lesions in the bones of the left clavicle, scapula, humerus and ribs.

ity of femur about its upper third with no crepitus, no ecchymosis and no tenderness.

Roentgen examination upon admission showed three pathological fractures in both femurs. Urine shows ordinary albumen as well as Bence-Jones protein. Meanwhile she has had more or less pain sometimes requiring morphine. Roentgen therapy was stopped in April because of the danger of more fractures and the feeling that it had very little influence on her condition, except for the relief of pain. A spiral fracture of the left femur, middle third occurred causing considerable pain. A month later a very slight tendency to callus formation was evidenced. Another month showed some return of motion although the limb healed in external rotation. The next month slight function returned. By August 1, condition had reached a level, which has since been maintained. In October a small bed sore developed which was quickly relieved by use of an air mattress. About this time a crepitating deformity of the right clavicle was noticed. Here radiating by the Alpine lamp was started and she says she feels better after it. Treatment had to be discontinued for a few days in October because of an erythema of the thigh. She has since had regular Alpine irradiation and has complained of no more pain. January, 1925, showed healing of the clavicle. Further roentgen examination showed repair of the three fractures of the femurs but no repair in the latest fracture of the left femur. The tumor has advanced in the pelvic bones and is far advanced in the other bones which were irradiated.

FIG. 7. Shows a pathological fracture of the right femur

FIG. 8. Shows a pathological fracture of the left femur.

Patient is still alive, nearly three years following the onset of her first symptom so that no pathological report on these tumors can be made.

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SOME NORMAL VARIATIONS AND PATHOLOGICAL CONDITIONS OF THE DIAPHRAGM*

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THE diaphragm is *not* an essential structure of the vertebrate body. Absence of half, or even all of it, is not incompatible with life. Likewise hernia of the diaphragm, of congenital nature, may not cause any incapacity of the individual. The writer had a striking confirmation of this in a case of a patient showing congenital absence of the left half of the diaphragm, with the presence of a large portion of the intestinal tract in the chest cavity. Furthermore the patient showed exceptional ability to perform strenuous tasks and even entered athletic contests. This patient was able to take part in a five-mile relay race among other events, and was a winner.

On investigating the development of the diaphragm one is particularly impressed by the fact that there is complete absence of the diaphragm in all animals up to mammals[1] (Fig. 1). In a frog, for example, the stomach is in contact with the heart. In fish, near the anterior end of the opening (body cavity) about opposite the posterior border of the gills, we find a transverse partition, the *false* diaphragm; back of this is the main body cavity; in front of the partition is the pericardial cavity.

In the development of the diaphragm there may be a deficiency in the musculature. This is particularly apt to occur on the left side and produce a congenital elevation of the diaphragm which is also known as eventration. The writer[2] has encountered a number of cases of eventration, and in one case (Figs. 3 and 4) was present at the autopsy and observed the extreme thinness of the diaphragm on the left side, so that it resembled in thickness, a piece of parchment.[2] Microscopic examination showed complete absence of all muscular structure. Occasionally eventration is present on both sides, in which case it is usually associated with congenital dilatation of the colon.[2] Acquired hernia of the diaphragm and particularly the congenital deformity known as thoracic stomach, may in some instances, cause considerable disability.[2]

The subphrenic space is divided into five cavities, any one of which may be involved in subphrenic abscess. Douglas[3] makes the following statement in this connection.

"The ligaments of the liver which are only folds of the peritoneum reflected from the liver surface to the diaphragm, divide the subphrenic area into five spaces, the falciform or broad ligament into a right and left area, and the coronary ligament into an anterior and posterior area, while the space between the reflections of the coronary ligaments over the posterior border of the liver forms a smaller extraperitoneal area. Lymphatic exudate with the resultant development of adhesions along the anterior border of the liver or at other places, determine, with the etiological factor causing the infection, the location of the abscess or fluid accumulation. The left posterior area forms the lesser peritoneal sac. For all practical purposes this would appear to be a sufficient division of these areas, although Knather distinguishes a right upper anterior and posterior, a right lower, and a left upper and lower anterior and posterior space. He says, however, that in the majority of cases pus will be found in more than one of these spaces."

* Read at the Sixth Annual Meeting, Eastern Section, American Roentgen Ray Society, Atlantic City, N. J., Jan. 22–24, 1925.

In reference to the typical physical signs of subphrenic abscess, Douglas states:

"These are the classical signs recorded and would probably be present if each layer or zone were superimposed on each other evenly like a pile of books or a layer cake. But they are not, and frequently the physical signs become most confusing.

"Roentgenographic study is the best method not only of confirming or making the diagnosis, but also of determining the position and the size of the fluid accumulation."

A cross section as illustrated by Eycleshymer and Schoemaker (Fig. 2), shows the close relationship between the costophrenic sinus of the thoracic cavity and the subphrenic space of the abdominal cavity. Owing to this fact an exploring needle may easily pass through the chest cavity into the abdominal cavity and in the case of subphrenic abscess, pus may be withdrawn giving the impression that it came from the chest cavity, whereas it really came from beneath the diaphragm, the exploring needle having passed through the diaphragm in this region.

In the roentgen examination, in order to gain the maximum information it is necessary to examine the patient in at least two positions one of which should be the upright, if possible. When the patient is too ill even to be turned, in addition to a dorsal exposure it is always possible to make a lateral exposure by placing the film against the patient's side and passing the ray through the body from side to side. In this way a fluid level may be demonstrated in cases containing air.

Few patients are so ill that they cannot be turned on the side, in order to make a straight lateral exposure which will show the costophrenic space. While the patient is on his left side an exposure should be made with the film against the front of the chest and abdomen and the ray passing through the body from behind forward.

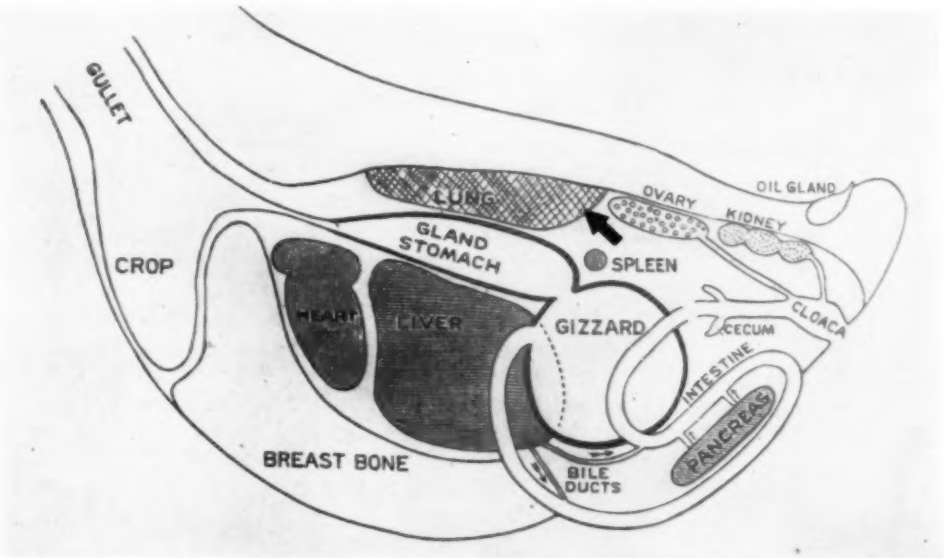

FIG. 1. Diagram illustrating the *absence* of the diaphragm in birds. Note that in all animals including vertebrates up to mammals there is normally *no* diaphragm.

This procedure may be reversed by placing the film against the patient's back and passing the ray in an anteroposterior direction. It is desirable to have both these if possible. Added information may be obtained by repeating this procedure with the patient lying on the opposite side. These lateral exposures are of particular value in those cases in which it is difficult to differentiate between a small collection of fluid above or below the diaphragm.

When the patient is able to sit up an examination should always be made in the upright position, first with the ray passing from behind forward to demonstrate a possible fluid level, and secondly with the film against the right side and the ray

passing from the left to the right to show the costophrenic space (Figs. 5 and 6).

In unusual cases exposures could be made in an extreme Trendelenburg position in order to determine the lower limit of the abscess cavity.

When gas is present with the exudate it is essential that the roentgenograms be taken in various positions in order to obtain fluid level. If no gas is present it may be necessary to perform artificial pneumoperitoneum, as advised by W. H. Stewart.

Collections of fluid and gas on the left side are occasionally encountered, as reported by Wessler and Jaches.[4] In a case of this sort it is necessary to bear in mind the fairly frequent occurrence of eventration of the diaphragm on the left side. A fluid level due to the stomach contents may closely simulate a subphrenic abscess (Fig. 3). The administration of an opaque meal may be necessary to clear up the diagnosis.

There may be present some exudate in the pleural cavity associated with a subphrenic abscess. It may become necessary to drain the pleural cavity in addition to the subphrenic abscess (Fig. 5). Abscess of the lung or a localized collection of fluid in the chest cavity may simulate subphrenic abscess, but a lateral exposure will usually clear up the diagnosis.

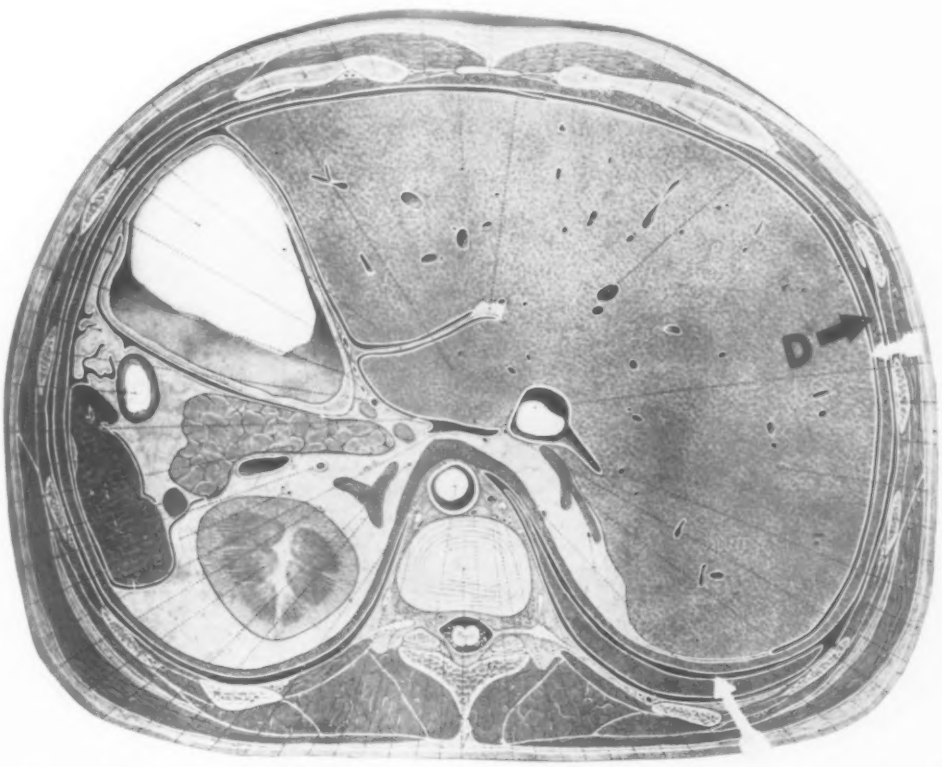

FIG. 2. Cross section. The small arrow indicates how an exploratory needle could easily pass through the pleural cavity into the peritoneal cavity through the diaphragm (D), and on withdrawal, in the case of subphrenic abscess, infect the pleural cavity. The larger arrow indicates the region of the costophrenic sinus (from Eycleshymer and Schoemaker).

Perforation of a hollow viscus may occur without giving roentgen evidence of free gas beneath the diaphragm. However, subphrenic abscess is likely to occur if operative intervention is not undertaken to relieve the condition. Abscess of the liver may simulate subphrenic abscess but would not necessarily cause as much elevation of the diaphragm. Furthermore, in the history there would be an absence of the acute symptoms, referable to a perforation of a hollow viscus.

FIG. 3. Eventration of the diaphragm on the left side. Note the heart is *displaced* to the right, simulating dextrocardia. The stomach however is on the left side. Autopsy showed absence of all muscle tissue in the left leaf of the diaphragm.

FIG. 4. Lateral exposure of eventration of the left side of the diaphragm shown in Figure 3. Note the left side of the diaphragm is several inches higher than the right; a reversal of the normal.

FIG. 5. Subphrenic abscess. Chest cavity entered without draining subphrenic abscess. Note the fluid level below the diaphragm.

FIG. 6. Lateral exposure of subphrenic abscess shown in Figure 5. Note the right side of the diaphragm is elevated several inches.

Perirenal abscess may simulate subphrenic abscess but there would usually be less elevation of the diaphragm.

In hernia of the diaphragm, especially if a hollow viscus such as the stomach, is partly or wholly in the chest cavity and partly filled with fluid and gas, there may be an appearance suggestive of subphrenic abscess. However, administration of an opaque meal usually will clear up the diagnosis. In one instance of hernia of the diaphragm, in which there was a portion of the colon on the right side above the liver, the appearance at times was somewhat suggestive of a fluid collection above the liver.

In the very unusual condition known as "thoracic stomach," the presence of fluid and gas may give the appearance of subphrenic abscess. Careful study after the administration of an opaque meal will make the diagnosis definite.

CONCLUSIONS

1. The preoperative diagnosis of subphrenic abscess can be made with certainty only by roentgenological examination.

2. Lateral roentgenograms are essential in making the diagnosis of subphrenic abscess.

3. The possibility of the presence of eventration of the diaphragm should always be considered in roentgenologic examinations for subphrenic abscess.

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EPILATION IN MICE AS A BIOLOGICAL STANDARD FOR DETERMINING ROENTGEN-RAY DOSAGE

(PRELIMINARY COMMUNICATION*)

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METHOD of determining the dosage of roentgen rays is by no means a solved problem. The pastille has been given up; the various electrical instruments are more suitable for the physicist than for the radiotherapist; dosage based upon a skin erythema is subject not only to variations in the persons tested, but also in a marked degree is dependent upon the eye of the reader. In addition it is certainly not desirable that any individual receive unnecessary erythema doses upon the skin. The only method which has stood the test of time is the arithmetical method of MacKee, and this naturally is not suitable for high voltage filtered radiation, especially in view of the varying outputs given by different machines. The one attack made upon MacKee's method has been that different Coolidge tubes may not give forth the same quantity of rays while operating under uniform conditions, owing to a difference in the glass.

It is generally conceded by all roentgenologists who have had experience in the treatment of tinea tonsurans that the minimum epilation dose for the human scalp is an absolutely fixed and certain quantity, and hence should prove an ideal biological check for dosage, were it only practical to use this method whenever desired. It occurred to one of the authors (H. H. H.) that it might be possible to utilize laboratory animals for this purpose, and mice were naturally selected. As is well known many authors have reported upon the epilation time in mice, some stating that the time required was four times that of the human, and others that it was six times as great.

* Read at the Sixth Annual Meeting, Eastern Section, American Roentgen Ray Society, Atlantic City, N. J., Jan. 22–24, 1925.

The first part of our problem was to establish the dosage necessary to produce epilation in mice, the second part was to see if mice epilated at a constant dosage. In experiments upon twenty mice we have shown that the time necessary to produce complete epilation is precisely six times that necessary in the human being.

Regarding the second point, we feel fairly certain that in young male mice the epilating dose for either radium or roentgen rays is absolutely fixed and constant. These conclusions are based upon a number of experiments.

The following tables show the results of our experiments with both roentgen rays and radium. The standard technique with the roentgen ray was: spark gap 7½ in., 4 ma., 9-in. distance, no filter. All treatments were given with the same tube and transformer. Twenty milligrams of radium in needles was employed in the radium experiments. It is estimated that about 97 per cent of the rays were gamma rays. No filter was employed and the needles were placed in an applicator next to the skin.

The results of the experiments were that mice receiving a sufficient dosage of either roentgen rays or radium epilated in three weeks. Mice receiving small irradiation dosage showed partial epilation in from four to six weeks. The irradiation dosage sufficient to produce epilation in three weeks is six units. Apparently the epilation dose in young, male mice is a constant one, although more experiments are needed to be absolutely certain upon this point.

TABLE I

Date of Irradiation	Dose in Units	Result Per Cent Epilation
Oct. 28, 1924	4	20, Dec. 14—6 weeks
Oct. 21, 1924	4⅓	35, Dec. 14—6 weeks
Nov. 22, 1924	4⅓	35, Dec. 24—4½ weeks
Nov. 22, 1924	4⅔	40, Dec. 24—4½ weeks
Oct. 28, 1924	4⅔	50, Dec. 14—6 weeks
Dec. 13, 1924	5	Died Jan. 8, no epilation
Dec. 12, 1924	5⅓	10, Jan. 16—5 weeks
Dec. 12, 1924	5⅓	50, Jan. 10—4 weeks
Aug. 27, 1924	5½	50, Sept. 18—3 weeks
Dec. 12, 1924	5⅔	30, Jan. 17—5 weeks
Aug. 27, 1924	5¾	90, Sept. 18—3 weeks
Dec. 13, 1924	6	100, Jan. 4—3 weeks
Aug. 27, 1924	6¼	100, Sept. 18—3 weeks

TABLE II

Date of Irradiation	Time, Min.	Result Per Cent Epilation
Dec. 4, 1924	25	90, Dec. 25—3 weeks
Dec. 4, 1924	35	100, Dec. 25—3 weeks
Dec. 4, 1924	40	100, Dec. 25—3 weeks
Aug. 29, 1924	45	100, Sept. 20—3 weeks
Aug. 29, 1924	60	100, Sept. 20—3 weeks
Aug. 29, 1924	90	100, Sept. 29—3 weeks

It is our intention to learn whether unfiltered rays with a long spark gap, or filtered irradiation will cause epilation with a relatively smaller number of units.

It is obvious that if this method be proven a success, numerous practical advantages will accrue.

(1) Radium can be standardized upon animals instead of upon human subjects.

(2) If it be proven that there is a difference in the output of Coolidge tubes they can likewise be standardized.

(3) It is possible that mice can be used to check up the accuracy of the various electrical devices for high voltage machines.

(4) The validity of the inverse square of distance law for filtered radiation can be proven or disproven.

(5) The biological accuracy of MacKee's arithmetical formula can be tested.

(6) Any possible effects of ultraviolet radiation, combined with irradiation, can be proven.

We are planning to work upon all of these points.

A THEORETICAL AND EXPERIMENTAL STUDY OF THE SMALL IONIZATION CHAMBER

(STUDIES ON THE PHYSICAL FOUNDATIONS OF ROENTGEN-RAY THERAPY. II)

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INTRODUCTION

IT is of great practical, as well as of theoretical importance to determine physical effects of roentgen rays, which over the whole range of wave lengths run parallel to the action of the rays on a certain biological system.* If such an effect could be practically recorded, it would in the first place define the ideal unit for the roentgen-ray dose for that particular biological system; and second, one would expect such an effect to be related fundamentally to the action of the radiation on the biological system so that the determination and analysis of such an effect would represent one method whereby to interpret the nature of the primary biologic effect of roentgen rays.

According to our present view all effects of roentgen rays are due solely to the secondary electrons which they produce. These secondary electrons are of two types,—photo-electrons and recoil-electrons. The photo-electrons, which are due to the photo-electric effect, all have the same energy, which is in inverse proportion to the wave length of the radiation (Planck-Einstein's Law); and is the same for all of the lighter substances. The number of photo-electrons increases very rapidly as the wave length increases and also as the absorbing substance increases in atomic weight. If the absorbing medium is a chemical element, the number of photo-electrons produced per gram is proportional to the third power of the atomic number. For a chemical compound of the form $a_1N_1 + a_2N_2 + \cdots$ their number is proportional to the so-called effective atomic number, which is defined by

$$N_{eff} = \frac{\sqrt[3]{a_1N_1^4 + a_2N_2^4 + \cdots}}{\sqrt{a_1N_1 + a_2N_2 + \cdots}} \qquad (a)$$

* The present discussion, of course, deals only with those biological systems which are acted on qualitatively in the same way by rays of different wave lengths.

Roentgen rays will therefore produce an equal number of identical photo-electrons in each gram of different light substances which have the same effective atomic number.

The existence of the second type of secondary electrons, the recoil-electrons, was quite recently predicted by Compton,[1] and Debye.[2] The properties of these recoil-electrons have been experimentally investigated by Wilson,[3] Bothe,[4] and Fricke and Glasser.[5] Recoil-electrons are produced by the process of scattering of the roentgen rays. They have a much lower velocity than the photo-electrons though their velocity increases rapidly with decreasing wave length. The velocity and number of recoil-electrons produced is the same for all the lighter substances. The total energy of the recoil-electrons as compared with the energy of the photo-electrons increases rapidly as the wave length decreases. For a wave length of 0.20 Å about 50 per cent of the total energy absorbed by water, and at 0.10 Å, practically all of the absorbed energy, is taken up by the recoil-electrons.

Returning to the problem of the constant relationship of the effects of roentgen rays of different wave lengths upon physical and biological systems, it is evident that a necessary condition for the existence of such a constant relationship must be that in each case the action depends on the production of the same relative number of photo- and recoil-electrons. This means that in each instance the medium in which the secondary electrons are produced must have the same effective atomic number. One point, which may be of importance in this connection, is that we are concerned only with the composition of that special part of the cell of the biological system in which the action of the rays takes place, or more accurately with that part together with that portion of

the surrounding area which is defined by the average path of a photo-electron. The chemical composition of these parts may very well differ from the average composition of the cell. It is of course mainly the cell content of the metallic salts, NaCl, KCl, etc., which is here of interest. The presence of 1 per cent of KCl, for instance, causes an increase of 15 per cent in the number of the photo-electrons; therefore a content of 6 or 7 per cent of this salt would amount to an increase of about 100 per cent in the photo-electric absorption. It is not unlikely that certain parts of a cell contain the latter amount of metallic salts.*

Among indicators of roentgen-ray intensity which may be expected to record correctly the biological action of the rays, the small ionization chamber is of special importance for two reasons. In the first place it is possible, as we shall see later, to make an ionization chamber so small that for the qualities of radiation commonly used in radiation therapy, the ionization produced would be due exclusively to the secondary electrons produced in the walls. We can therefore comply with the condition specified above concerning the composition of the indicator simply by selecting as wall material a chemical compound which has the same effective atomic number as that part of the cell in which the action of the rays takes place. Moreover, there is evidence that the ionization produced by roentgen rays in a gas is fundamentally related to the chemical, biological and similar effects of the rays on a liquid system. This evidence is based on direct experimental data, as well as on our present theoretical conceptions. First of all, the experiments of Owen[6] and others prove that the relative number of ions produced by roentgen rays in different gases is independent of the wave length of the rays. This fact shows that the specific nature of the gas would be of no importance for our problem. Furthermore, experiments show† that when different types of radiation produce a chemical transformation in a gas or in a liquid, the number of new molecules formed is very often approximately equal to or a simple multiple of the number of ions produced by complete absorption of the rays in a gas. One would therefore expect also that a constant relationship would exist between the ionization in a gas and the biological action, since in its final analysis this must be of a chemical character.* Our present theoretical conceptions support this statement.

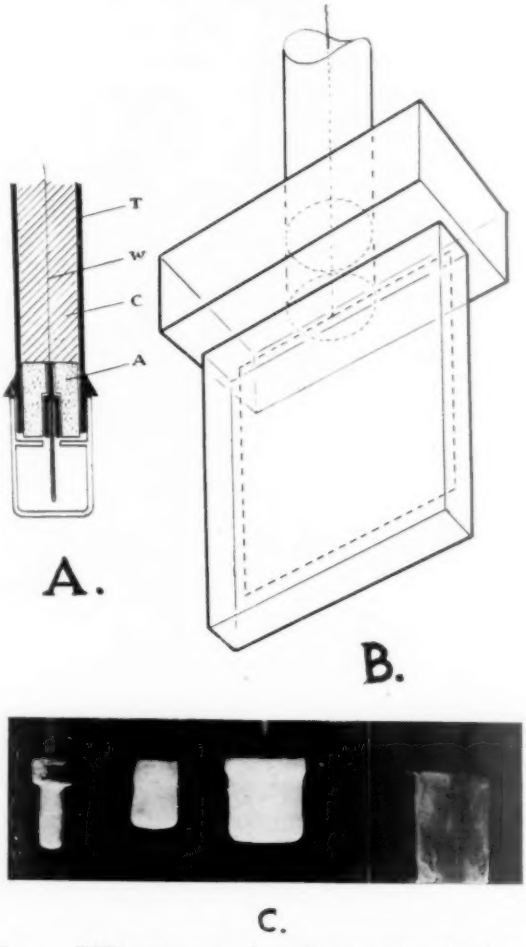

FIG. 1. Different types of small ionization chambers
A. End piece of tubing leading to electroscope attached to ionization chamber.
B. Attachment of rectangular chamber to tubing by means of an adaptor.
C. Three ionization chambers made of salts and one of tinfoil.

We have previously stated that the action of roentgen rays is solely due to the

* The existence of an effect of this magnitude would mean, for instance, that the reading from a large air chamber which had been calibrated with very hard rays would for this reason alone be 100 per cent too low for very soft rays.

† See, for instance, review given by Lind.[7]

* These considerations do not take into account the fact that biological systems are non-homogeneous.

secondary electrons which they produce. The energy of these secondary electrons (or a nearly constant fraction thereof)* is used in transforming a certain number of molecules of the biological system into certain definite modifications which are defined by the conditions given by the quantum theory. Completely ionized molecules constitute one type of these modifications but there are also numerous other types. Some or all of these modified molecules will pass over into new chemical combinations and thus start abnormal transformations in the cell. Theoretically we would expect that the relative number of these modified molecules would not depend on the energy of the secondary electrons (and therefore not on the wave length). This conception is in accordance with the experimental findings referred to above, that the relative number of ions produced by rays in different gases is independent of the wave length of the rays. Consequently the number of modified molecules of any specific type which are present, the number of ions for instance, would be characteristic for the total effect of the rays. (This consideration is of course valid in spite of the fact that on account of their fast recombination the life of the ions in a liquid system is very short.) Since, as stated above, the relative number of ions produced in different gases is independent of the wave length of the radiation, one may expect that a similar constant relationship will also exist for the case of a gas and a liquid, and therefore, since the number of ions in the liquid is characteristic for the total chemical (or biological) effect, the number of ions in a gas must be so too.

A number of investigations testing this point have already been made. Friedrich,[8] Holthusen,[9] Russ,[10] Redfield and Bright,[11] Martius,[12] Wood[13] and others have compared the effect of roentgen rays of varying wave lengths on different biological systems with the ionization of atmospheric air. Though the results obtained are far from consistent, it seems that within the limit of accuracy the effects on some of the biological systems have a constant relationship to the ionization in air while for other systems the effect has been found to be relatively larger for rays of longer wave length. Frequent comparisons of the biological action of roentgen rays on the human skin and the ionization of air show that the relationship here is constant for wave lengths varying from 0.20 Å up to hard γ-rays, while for softer rays the biological effect is comparatively too large. The experimental data however are not sufficiently accurate nor extensive to permit definite conclusions as to the possible deviations caused by a difference between the effective atomic numbers of air and the part of the cell which is sensitive to the rays. Experimental work on this problem is at present being carried out in this laboratory. It has its foundation in the investigations of the relationship of the ionization-current to the shape, volume and material of the ionization chamber, which are presented in this paper.

* Compare Fricke and Glasser.[5]

EXPERIMENTAL TECHNIQUE

The ionization chambers used for our investigations were cylindrical or rectangular in shape and of different volumes. The dimensions of the four main types are shown in Table 1.

In Figure 1 the photograph, c, shows the four types which were used, a and b being diagrams of the two principal types.

The chambers were constructed of certain chemical elements and their salts. Many of the materials tested could not be used because they were impure, unstable or hygroscopic. The metal chambers were made of thin foils. The salt chambers were constructed as follows: A metal pattern of the required dimensions and form was covered by a thin deposit by dipping it in the melted salt. After cooling, this deposit was removed, thus forming the wall of the ionization chamber. In this way salt chambers with walls of a fraction of a millimeter in thickness can be made. This method of building chambers does not permit the use of salts which decompose or undergo chemical changes at higher temperatures or which have relatively high melting points.

All of the chambers were sufficiently conductive except the sulphur chamber. To make this chamber conductive, its

TABLE I

A	B	C Ionization Chamber			D Electrode			E
Type	Form	Dimensions		Vol. in C.c.	Dimensions		Vol. in C.c.	Eff. Vol. of Chamber in C.c.
		Length in Cm.	Diam. in Cm.		Length in Cm.	Diam. in Cm.		
I	Cylinder	2.060	0.558	0.503	2.000	0.119	0.022	0.481
II	Cylinder	1.112	1.095	1.050	1.000	0.119	0.011	1.039
III	Cylinder	1.540	2.020	4.928	1.400	0.119	0.015	4.913
IV	Rectang.	$3.0 \times 3.0 \times 0.50$		4.500	$2.4 \times 2.4 \times 0.023$		0.133	4.467

inner surface was coated with a thin layer of graphite; special experiments showed that the ionization current was not influenced by the presence of the graphite layer.

The determination of the ionization currents was carried out by the electroscopic method described in detail in Part I of this report.[14] In Figure 1, *a* shows the endpiece of the tubing leading to the electroscope with the ionization chamber attached. The inner wire W connecting the gold leaf to the inner electrode of the chamber is insulated from the grounded brass tube T by ceresin C and amber A. A series of hard rubber adapters with amber insulation was used to connect the different chambers to the brass tubing. B in Figure 1 shows the attachment of a rectangular chamber to the tubing by means of an adapter. The chamber of the type II which was principally used for our investigations could also be directly attached to the tubing without an adapter. By using these insulating adapters the wall of each chamber could be charged to any potential and thus any desired difference of potential in the chamber could be procured without changing the potential at the electroscope. This was of importance in testing the saturation current for each chamber.

A Kelley-Koett 280 kv. transformer, type U, with disc rectification and Coolidge Universal tube with tungsten target were used in all the experiments.

The potential necessary to produce the saturation current was determined for each type of chamber. In Figure 2 are shown graphically the ionization currents in chambers of types I and II (see Table I). The curve for chamber II illustrates the difficulty of obtaining complete saturation in certain types of chambers. For the chambers of type III and IV saturation was produced at a potential difference of 100 volts.

THE DEPENDENCE OF THE IONIZATION CURRENT UPON THE CHEMICAL COMPOSITION OF THE WALL OF THE CHAMBER

To illustrate how the ionization current depends upon the chemical composition of the wall of the chamber the data in Table II are reported, these being the values of the ionization current in chambers of type II for one radiation quality. A series of chambers were constructed from the materials indicated in the table and the ionization currents were measured, the currents $I_{obs.}$ being given relatively to the current produced in the carbon chamber. The conditions of radiation were: 200 kv. and 0.48 mm. Cu + 1 mm. Al filter.

The increase of the ionization current with the increase in the atomic number is due to the fact that a part of the ionization is produced by the photo-electrons from the inner surface of the chamber wall. As already stated the number of these electrons increases with the third power of the atomic number. The simplest graphic representation of the results given in Table II can therefore be made if the abscissas represent the third powers of the effective atomic numbers of the materials used, the ordinates representing the respective ionization currents. The fact shown in Figure 3 that a straight line (termed the $I\text{-}N^3_{eff}$-line) is obtained may be explained as follows: The ionization current produced by the radiation in the chamber is composed of three parts; one

due to the recoil electrons, one to the photo-electrons from the wall of the chamber, and a third to the photo-electrons from the air in the chamber. It can be shown that the first part is independent of the material of the chamber while the second is proportional to the third power of the effective atomic number of the wall material. The third part is independent of the composition of the wall. Consequently when C_1 and C_2 are independent of the material of the chamber, the total ionization current may be represented by the following equation:

$$I = C_1 + C_2 N^3_{eff} \qquad (b).$$

The equation is linear in regard to N^3_{eff}. If the chamber is so small that the number of photo-electrons produced in the air of the chamber is negligible C_1 represents the ionization current due to the recoil-electrons, $C_2 N^3_{eff}$ the current due to the photo-electrons of the chamberwall. If from this equation (b) we calculate the currents for the special conditions given above (Table II) taking the constants C_1 and C_2 as 0.825 and $\frac{0.175}{6^3}$ respectively, we obtain the values I_{calc} in column F of Table II. The agreement between the observed and the calculated values is satisfactory.

The dependence of the relative values of the constants C_1 and C_2 or the slope of the I-N^3_{eff}-lines in the graphic representation on the quality of the radiation is demonstrated in Figure 4. Here the ionization currents for different materials are given for the following radiation conditions:

(a) 100 kv., 2 mm. Al
(b) 100 kv., 0.43 g/sq. cm. tungstic acid + 0.13 mm. Cu + 1 mm. Al
(c) 200 kv., 0.48 mm. Cu + 1 mm. Al
(d) 200 kv., 0.55 g/sq. cm. Ag + 0.75 mm. Cu + 1 mm. Al

(The rays produced by the conditions b and d were practically homogeneous and had the wave lengths 0.180 Å and 0.115 Å respectively.[5])

The measured results are given in Table III and are graphically represented in Figure 4.

The fact that the slope of the I-N^3_{eff}-lines becomes smaller and smaller with decreasing wave length is due to the fact that the energy of the recoil-electrons increases in comparison to that of the

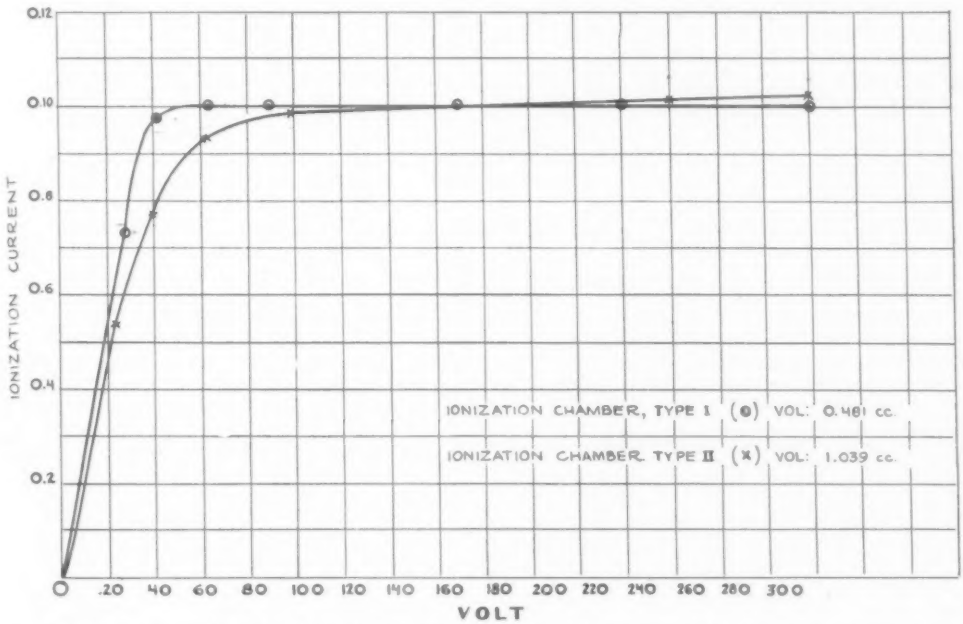

FIG. 2. Graphic presentation of values given in Table I for ionizing currents in chambers of types I and II.

TABLE II

Conditions: 200 kv. 0.48 mm. Cu + 1 mm. Al.
Volume of Ionization Chamber: 1.039 c.c. (Type II).

A Material	B Composition	C Producer	D Eff. Number N	E N^3_{eff}	F $I_{obs.}$	G $I_{calc}(=0.175\frac{N^3}{6^3}+.825)$	H $\Delta\%$
Graphite	C	Nat. Carbon Co., Cleveland, O.	6.0	216.0	1.00	1.00	0
Urea c.p.	N_2H_4CO	I. T. Baker Chem. Co., Phillipsburg, N. J.	6.25	244.4	1.03	1.02	−1
Maleic acid, c.p.	$C_2H_2O_2$	Spec. Chem. Co., Highland Park, Ill.	7.11	359.7	1.08	1.11	−3
Ammonium nitrate, c.p.	NH_4NO_3	Powers-Weightman Co., Philadelphia, Pa.	7.47	416.8	1.15	1.16	−1
Atm. air	23.2% O+ 75.5% N+ 1.3% A	.....	7.69	454.5			
Sodium nitrate, c.p.	$NaNO_3$	Powers-Weightman Co.	8.85	692.9	1.39	1.39	0
Magnesium (99.995% pure).	Mg	* Am. Magn. Corp., Niagara Falls, N. Y.	12.0	1728.0	2.23	2.23	0
Aluminum (99.5% pure).	Al	* Al. Comp. of Am., Pittsburgh, Pa.	13.0	2197.0	2.60	2.61	0
Potassium nitrate, c.p.	KNO_3	Powers-Weightman Co.	14.3	2924.4	3.16	3.19	−1
Sulphur comm.	S	Merck Co., New York	16.0	4096.0	4.00	4.15	−4

* We wish to express our appreciation of the courtesy of the American Magnesium Corporation and the Aluminum Company of America for supplying us with the materials for these chambers.

TABLE III

Conditions of Radiation: (*a*), (*b*), (*c*) and (*d*).
Volume of Ionization Chamber 1.039 c.c. (Type II).

A Material	B N^3_{eff}	C Intensity			
		Qual. (*a*)	Qual. (*b*)	Qual. (*c*)	Qual. (*d*)
Graphite	$6^3 = 216$	1.00	1.00	1.00	1.00
Magnesium	$12^3 = 1728$	2.71	2.50	2.23	1.55

photo-electrons, as stated above. Ionization chambers of different materials thus tend to give the same currents with increasing hardness. With 200 kv. and heavy filtration, for instance, it is possible to produce a radiation which causes a difference of only 15 per cent in the ionization produced in a graphite and in an aluminum chamber. For hard γ-rays the ionization produced in a carbon chamber will be practically equal to that in an aluminum chamber.

The problem of constructing the I-N^3_{eff}-line for a definite condition of radiation is easily solved by measuring the ionization currents in two chambers of different materials.* When the values measured are plotted in the manner described above, the desired I-N^3_{eff}-line is obtained by connecting the two experimental points. The lines in Figure 4 were plotted in this way from the readings in the carbon and the magnesium chambers. It is important to mention here that the relative values of the ionization currents for different materials are independent of form and size of the chamber if the size is limited to a certain maximum. This independence will hold true as we shall see later for chambers of about 1 c.c. and for the qualities of radiation ordinarily used in therapy.

* We found graphite and magnesium very suitable for this purpose as these materials could be easily obtained in a pure state.

THE DETERMINATION OF THAT PART OF THE TOTAL IONIZATION WHICH IS DUE TO THE RECOIL-ELECTRONS

If the chamber is small enough C_1 and $C_2N^3_{eff}$, as already stated, represent the parts of the total ionization due to the recoil- and photo-electrons respectively. Each of these constants can easily be determined for any specific type of radiation by means of the I-N^3_{eff}-line (Fig. 4). If this line is continued backward until it intersects with the ordinate, this section

of the ordinate will indicate the current produced in an ionization chamber with walls of the effective atomic number 0. This current is due to the recoil-electrons, the number of which is independent of the atomic number, and to the photo-electrons from the air of the chamber. If the air volume is small in comparison

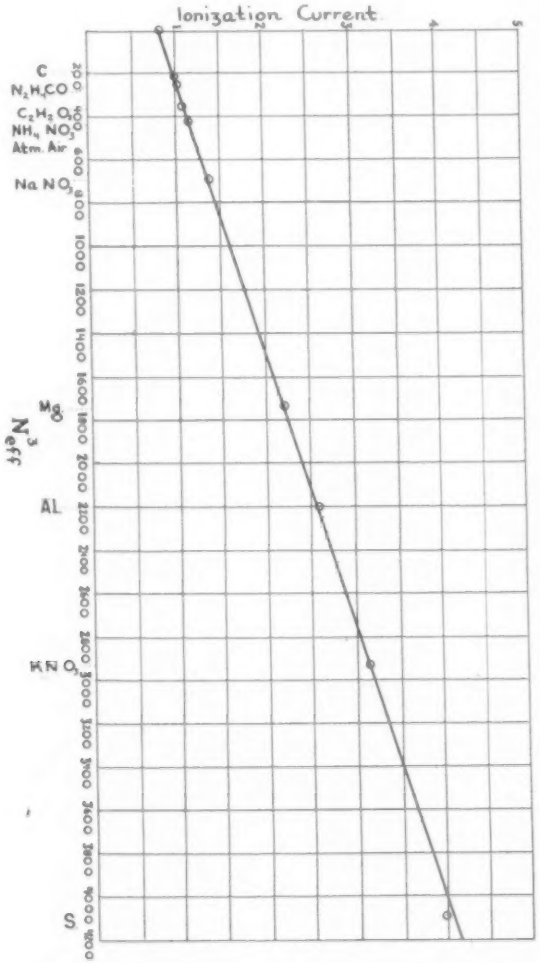

FIG. 3. Graphic presentation of results given in Table II.

to the range of a photo-electron in the air of the chamber the latter part is negligible. In this case which for chambers of a capacity of a few cubic centimeters holds for the types of radiations used in deep therapy, the ordinate value for N = 0 represents the ionization due to the recoil-electrons. For example, for the curve c in Figure 4 this value is 0.83; that is, since the total ionization current in the carbon chamber is 1, 83 per cent of the current in this chamber is due to the recoil-electrons, the remaining 17 per cent being due to the photo-electrons. In Figure 4 the diagram in the upper left hand corner shows the intersections of the lines with the ordinate on an enlarged scale.

THE DEPENDENCE OF THE IONIZATION CURRENT UPON THE VOLUME AND THE SHAPE OF THE CHAMBER

As we shall explain presently, it is theoretically to be expected that the ionization current for each specified material and radiation is directly proportional to the volume of the chamber if its dimensions are small compared to the path of the photo-electron in air. The observations given in Table IV prove that this condition for chambers of a volume of a few cubic centimeters is fulfilled for the qualities of radiation used in deep therapy. Chambers of the types I, II, III and IV made of carbon and aluminum, were investigated for the radiation conditions a, b, c, and d. The values of the ionization currents for each specified quality of radiation are given relatively to the value of the current in the carbon chamber of type II. The ionization currents per cubic centimeter of volume $\left(\frac{I}{V}\right)$ are given in column C of the table and are seen to be the same for each specified material and radiation.

TABLE IV

A	B	C							
Type	Vol. of Chamber in C.c.	Intensity/Volume							
		Qual. (a) C	Al	Qual. (b) C	Al	Qual. (c) C	Al	Qual. (d) C	Al
I	0.481	....	3.25	0.98	2.92	1.00	2.56		
II	1.039	1.00	3.25	1.00	2.96	1.00	2.57	1.00	1.73
III	4.913	1.03	3.32	0.98	2.94	1.00	2.57		
IV	4.467	1.00	3.25	0.98	2.96	....	....	0.99	1.71

This fact can be explained as follows: In an infinitely small cavity in a homogeneous medium, placed in a constant field of roentgen rays, there is an atmosphere of fast electrons; partly recoil-electrons and partly photo-electrons. The composition of this atmosphere depends on the relation of the production of the

secondary electrons to their absorption (and stopping). For any specified substance both effects are proportional to the density. We may thus conclude that the composition of the electronic atmosphere does not change with different densities of a medium of a constant chemical composition. Since the emission of recoil-electrons per gram electron is independent of the chemical composition for lighter substances, and the emission of photo-electrons per gram electron is proportional to the third power of the effective atomic number, while the absorption and stopping per gram electron is independent of the chemical composition, we conclude that a change in the chemical composition of the medium will cause a change in the photo-electron atmosphere only. This change will consist in an increase in the number of photo-electrons within each defined range of velocities proportional to the third power of the effective atomic number of the medium, as expressed above in equation (b). If the cavity is filled with a gas a certain number of ions will be produced. The number of these ions is evidently proportional to the volume of the cavity, provided this is so small that its presence does not disturb the existing equilibrium. Since the composition of the recoil-electron atmosphere is independent of the composition and density of the medium, this will be true if the dimensions of the cavity are small compared to the range of a photo-electron in the gas.

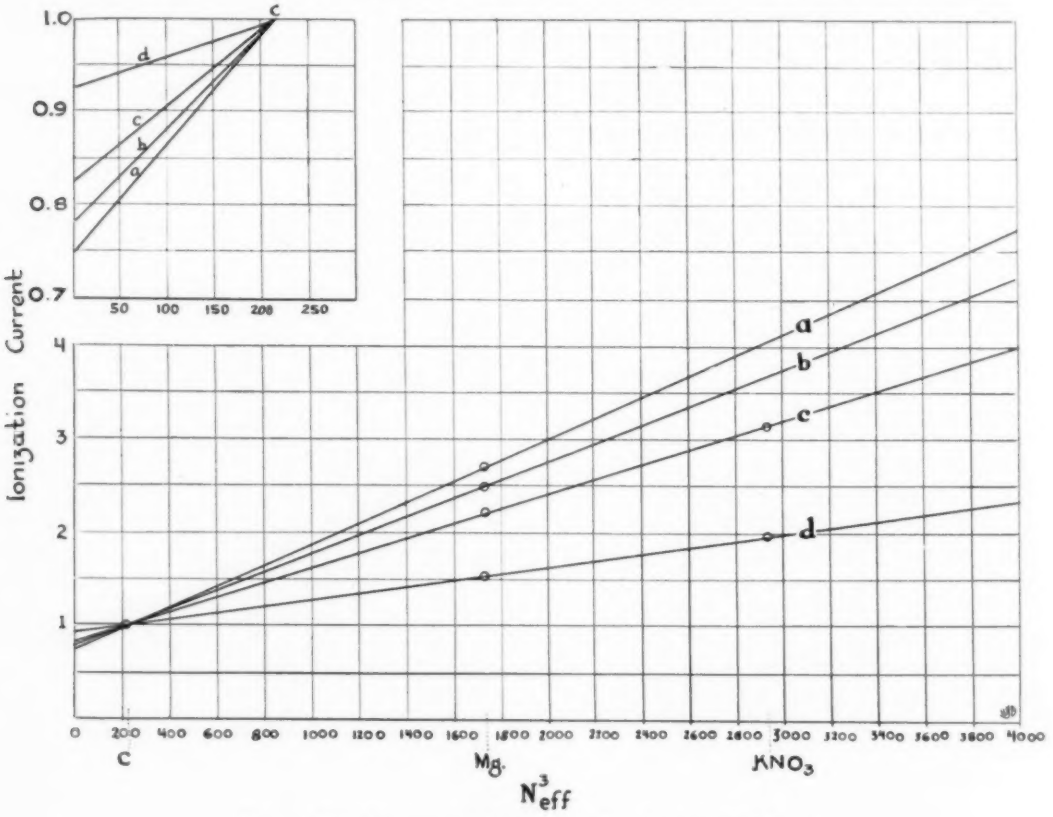

FIG. 4. Graphic presentation of results given in Table III.

For very large chambers the ionization current is proportional to the volume only in case the wall of the chamber has the same effective atomic number as atmospheric air, i.e., 7.69, using formula (a) given in the introduction. According to the foregoing, the ionization current produced in such a chamber is equal to that produced in the same volume of air within an indefinitely extended air volume. In the next section of this report we shall

discuss the problem of using this chamber for a standard measurement of the roentgen-ray intensity.

CONCLUSIONS

(1) The ionization current produced in chambers whose dimensions are small as compared to the range of a photo-electron in air is independent of the size and form of the chamber, and is directly proportional to the volume. This relation for chambers with a volume of approximately 1 c.c. holds for the radiation conditions ordinarily used in roentgen therapy.

(2) The ionization currents produced in small chambers of different materials may be represented by the equation

$$I = C_1 + C_2 N^3_{eff}$$

in which N_{eff} is the effective atomic number of the material of the wall.

(3) The graphic representation of this relationship gives a straight line, if the third powers of the effective atomic numbers of the materials are used as the abscissas, the respective ionization currents being the ordinates. The calculation of the constants C_1 and C_2 or the construction of the straight line for any quality of radiation may be made by measuring the ionization currents in two chambers of different materials and plotting the results in the manner described.

(4) The intersection of the straight line with the ordinate determines that part of the total ionization in a small chamber which is due to the recoil electrons.

(5) A chamber with walls of the same effective atomic number as atmospheric air (7.69) will always give an ionization current which is proportional to its volume, and equal to the current produced in the same volume of an infinitely extended air space.

(6) It is proposed to define the unit for the roentgen-ray intensity by means of such a chamber.

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STANDARDIZATION OF THE ROENTGEN-RAY DOSE BY MEANS OF THE SMALL IONIZATION CHAMBER

(STUDIES ON THE PHYSICAL FOUNDATIONS OF ROENTGEN-RAY THERAPY. III)

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INTRODUCTION

SEVERAL units for the roentgen-ray dose have been proposed since roentgen rays were first used for therapeutic purposes. These units (F, H, S.U.D., e, E, R are based on physical, chemical, physiological or other properties of the rays. There is, however, a general agreement that the most important of these units is one based on the ionization of air because of the fact that the biological effect of this unit is independent of the quality of the radiation over a rather large range of wave lengths. Different units based on ionization of air have been introduced (Villard[1], Scilard,[2] Friedrich,[3] and others); one is the R-unit which recently was introduced by the German Roentgen Ray Society.[4] It is defined as follows: "The absolute unit of the roentgen-ray dose is obtained from that roentgen-ray energy which by fully utilizing the secondary electrons produced and by avoiding secondary radiations from the wall of the ionization chamber produces in 1 c.c. of atmospheric air, under normal conditions, such a degree of conductivity that the quantity of electricity measured by saturation current equals one electrostatic unit." We have accepted this unit since it is the only one which has been officially recognized by a roentgen-ray society.

According to the foregoing paper, a chamber which is made of a material of the same effective atomic number as atmospheric air (7.69) measures the roentgen dose directly in R-units. We shall here describe the practical construction of such a chamber which we shall call the small standard chamber, together with its practical application in the determination of the erythema dose in R-units.

THE SMALL STANDARD AIR CHAMBER

The experimental definition of the R-unit by means of the small standard air chamber can be expressed as follows: "The standard unit of the roentgen-ray dose, one roentgen, (1R) is that dose which produces by saturation an ionization of one electrostatic unit in a volume of one cubic centimeter of atmospheric air, under normal conditions, and is completely surrounded by a substance which has the same effective atomic number as atmospheric air (7.69) and does not contain elements whose critical wave lengths are within the range of wave lengths used in roentgen-ray therapy."

The small standard air chamber which we have found most practical in daily use, is constructed from carbon, the inner surface of which is coated evenly with thin strips of magnesium foil. The relative areas are 100 carbon to 18.6 magnesium. We have used these two elements, because we have found it possible to obtain them in a very pure state.* The currents obtained for different radiation conditions in this chamber and in a carbon and a magnesium chamber are given in Table 1.

By the method described in the foregoing paper, we can calculate the ionization currents for the small standard air chamber by means of the currents obtained in the carbon and in the magnesium chamber. The values obtained as given under $I_{calc.}$ are seen to be in very satisfactory agreement with the observed values. This procedure may be illustrated by the following example: for the conditions c, (200 kv.; filter, 0.48 mm. Cu + 1 mm. Al) the currents observed for the carbon and magnesium chamber are 1 and 2.23 in arbitrary units. We plot these values as ordinates, taking the third powers (216 and 1728) of the atomic numbers (6 and 12) of carbon and magnesium as abscissas. We connect the points obtained by a straight line (the so-called $I\text{-}N^3_{eff}$ line). The current for the standard air chamber

* We wish to express our appreciation of the courtesy of the American Magnesium Corporation which supplied us with the magnesium foil which was used in this research.

TABLE I

Conditions of Radiation: (*a*), (*b*), (*c*), and (*d*).
(*a*) 100 kv., 2 mm. Al.
(*b*) 100 kv., 0.43 g/sq. cm. tungstic acid + 0.13 mm. Cu + 1 mm. Al.
(*c*) 200 kv., 0.48 mm. Cu + 1 mm. Al.
(*d*) 200 kv., 0.55 g/sq. cm. Ag + 0.75 mm. Cu + 1 mm. Al.

Ionization Chamber: Type II. Volume 1.039 c.c.

A Material	B N^3_{eff}	C Qual. (*a*) (soft)		D Qual. (*b*)		E Qual. (*c*)		F Qual. (*d*) (hard)	
		$I_{obs.}$	$I_{calc.}$	$I_{obs.}$	$I_{calc.}$	$I_{obs.}$	$I_{calc.}$	$I_{obs.}$	$I_{calc.}$
Graphite	$6^3 = 216$	1.00	(1.00)	1.00	(1.00)	1.00	(1.00)	1.00	(1.00)
Standard Chamber (atm. air)	$7.69^3 = 454.5$	1.30	1.27	1.23	1.23	1.19	1.19	1.09	1.09
Magnesium	$12^3 = 1728$	2.71	(2.71)	2.50	(2.50)	2.23	(2.23)	1.55	(1.55)

is the ordinate of this line for the abscissa $7.69^3 = 454.5$, and is found to be 1.19.

COMPARISON OF STANDARD AIR CHAMBER WITH COMMERCIAL IONTOMETERS

The calibration of most commercial iontometers depends upon the wave length of the radiation. This is also true for commercial iontometers having small ionization chambers of light materials like horn, graphite, ivory, etc., because the effective atomic number of these substances generally is different from that of atmospheric air, i.e., 7.69. In Table II are given the results of a comparison of our standard air chamber with chambers of different light substances which have frequently been used in practical work. The comparisons have been made for three different conditions of radiation, viz., a, c, and d.

TABLE II

Conditions of Radiation: (*a*), (*c*), and (*d*).
(*a*) 100 kv., 2 mm. Al.
(*c*) 200 kv., 0.48 mm. Cu + 1 mm. Al.
(*d*) 200 kv., 0.55 g/sq. cm. Ag + 0.75 mm. Cu + 1 mm. Al.

Ionization Chamber: Type II. Volume 1.039 cc.

A Material	B Ionization Current		
	Qual. (*a*) (Soft)	Qual. (*c*)	Qual. (*d*) (Hard)
Graphite	0.77	0.84	0.91
Redmanol	0.81	0.87	0.93
Celluloid	0.82	0.83	0.88
Filter paper	0.92	0.89	0.96
Writing paper	0.92	0.90	0.97
Horn	0.87	0.92	0.99
Atm. air	1.00	1.00	1.00
Aluminum	3.2	2.6	1.7

ERYTHEMA DOSE AS DETERMINED WITH A SMALL STANDARD AIR CHAMBER

A series of measurements were made on patients with the small standard air chamber to determine the erythema dose in R-units. The average biological effect produced on the skin was a slight erythema of the first degree. One example may illustrate the manner of determining the erythema dose.

Transformer: Kelly-Koett, 280 kv., type U.

Tube: Coolidge universal with tungsten target.

Conditions of Radiation: 200 kv., 8 ma., 1 mm. Cu + 1 mm. Al. 50 cm. FSD, 20 × 20 cm. port of entry.

Erythema dose for these conditions as given by Dr. U. V. Portmann of the Roentgen Therapy Department of the Cleveland Clinic: 65 min.

Capacity of dosimeter: 63.7 cm.

Voltensitivity of dosimeter electroscope: 4.0 volt/Div.

Discharge time of dosimeter electroscope over 10 Div.: 23.1 sec. (ionization chamber in center of field on skin of the patient).

Volume of ionization chamber: 1.039 c.c.

Using the formula $Q = \frac{C \times V}{300}$ the following number of R-units for the erythema dose are calculated:

$$\frac{63.7 \times 40 \times 65 \times 60}{23.1 \times 300 \times 1.039} = 1380 \text{ R}$$

Our measurements thus far show that this erythema dose of about 1400 R

holds for conditions of radiation from 130 kv. and 4 mm. Al up to 200 kv. and 1 mm. Cu filter.

CONCLUSIONS

1. It is suggested that a small ionization chamber of a material with an effective atomic number equal to that of atmospheric air (7.69) be used as base for the experimental definition of the standard unit R (one roentgen) of the roentgen-ray dose.

2. The construction of such a small standard air chamber is described.

3. This standard chamber is compared with iontometers made from different commercial substances.

4. The erythema dose was measured with this standard chamber and found to be 1400 R for fairly hard rays.

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Twenty-sixth Annual Meeting: At Washington, D. C. September 22–25, 1925.

SECTIONS OF THE AMERICAN ROENTGEN RAY SOCIETY

EASTERN SECTION: RALPH LEONARD, Chairman, Boston, Mass., HOWARD E. ASHBURY, Vice-Chairman, Baltimore, Md., F. M. HODGES, Secretary, Richmond, Va.

Seventh Annual Meeting: To be announced.

CENTRAL SECTION: RAYMOND C. BEELER, Chairman, Indianapolis, Ind., LAWRENCE REYNOLDS, Vice-Chairman, Detroit, Mich., E. R. BADER, Secretary, Cincinnati, O.

Seventh Annual Meeting: At Chicago, Illinois.

WESTERN SECTION: H. B. THOMPSON, Chairman, Seattle, Wash., IRVING INGBER, Secretary, San Francisco.

Combined meeting with Pacific Coast Roentgen Ray Society, Hotel Oakland, Oakland, Calif., July 9, 10 and 11, 1925.

THE AMERICAN RADIUM SOCIETY

President: WM. S. NEWCOMET, 3501 Baring St., Philadelphia; *President-Elect:* DOUGLAS QUICK, N. Y. C.; *First Vice-President:* ALBERT SOILAND, Los Angeles; *Second Vice-President:* E. C. SAMUEL, New Orleans; *Secretary:* E. C. ERNST, St. Louis; *Treasurer:* R. E. LOUCKS, Detroit.

Executive Committee: GEO. E. PFAHLER, Chairman, Philadelphia, R. E. LOUCKS, Detroit, JAMES T. CASE, Battle Creek, Mich.

Program Committee: DOUGLAS QUICK, Chairman, N. Y. C., LEDA J. STACY, Rochester, Minn., H. W. VAN ALLEN, Springfield, Mass.

Membership Committee: SANFORD WITHERS, Chairman, Denver, Colo., ISAAC GERBER, Providence, R. I., B. R. KIRKENDALL, Columbus, O.

Publication Committee: H. K. PANCOAST, Chairman, Philadelphia, G. FAILLA, N. Y. C., E. C. ERNST, St. Louis.

Standardization Committee: WM. DUANE, Chairman, Boston, HENRY SCHMITZ, Chicago, A. WEATHERWAX, Philadelphia.

Tenth Annual Meeting: At Chalfonte-Haddon Hall, Atlantic City, N. J., May 25–26, 1925.

EDITORIALS

RIEDEL'S STRUMA: WOODY THYROIDITIS

THIS unusual disease of the thyroid is of importance because it is almost invariably mistaken for carcinoma. Although the two conditions have striking points of similarity, the mistake is in the main due to lack of familiarity with Riedel's struma as a clinical entity.

This is well illustrated by a typical case recently seen which was referred by an experienced thyroid surgeon for radiation treatment of an inoperable carcinoma of the thyroid,—a diagnosis in which the writer at first concurred.

The patient was a white woman, aged fifty-five. About a year previously she had noticed a small lump in the region of the right lobe of the thyroid which caused her no concern until six weeks ago when her neck began to enlarge rapidly. In a short while she was unable to speak above a whisper and swallowing was becoming increasingly difficult. She was somewhat nervous, but was probably correct in attributing it to anxiety over her condition. She had had no pain, other than a few twinges in the region of the left ear. The pulse was slightly accelerated. There was no tremor, exophthalmos or other symptoms indicating thyroid intoxication. Her basal metabolic rate was minus 8 per cent. There was a marked swelling on the front of the neck extending from chin to sternum, almost entirely obliterating the submental curve. It was of board-like hardness and was not nodular, edematous, reddened nor tender. All of the structures on the front of the neck, including the larynx and sterno-mastoids felt as though they were fused into a solid, extremely hard mass. There was no evidence of intrathoracic metastasis or disease of the bones. The laryngologist reported that there was a lateral anterior compression of the larynx on both sides affecting the glottic and subglottic spaces. The true cords were bowed convexly inwards. They were separated only in the posterior third and did not move during phonation or respiration. The arytenoid space was edematous and the cartilages could not be singled out. The aryepiglottic fold and false cords were swollen, but there was no prolapsus. The laryngologist was under the impression that the thyroid had invaded the posterior laryngeal structures and the anterior esophageal wall.

Roentgen-ray treatment of this case was undertaken with considerable trepidation on account of the existing edema of the larynx, but the response to treatment was immediate and rapid. At the expiration of two weeks the mass was reduced at least 50 per cent in size and at the end of a month all that remained of it was a little enlargement at the isthmus which is probably the remains of a nontoxic, nonmalignant adenoma. The patient phonates well, swallows without difficulty, and her general condition is satisfactory.

This case would undoubtedly have been recorded as an unusual response of a carcinomatous thyroid to radiation therapy had not a review of the literature brought to light the fact that it corresponds in every particular to the "iron-hard strumitis" described by Riedel in 1896.

Crotti in his book on the "Thyroid and Thymus" gives an excellent description of this disease under the term "woody thyroiditis," a designation given it by Ricard in 1901, and emphasizes the points of differential diagnosis from carcinoma which it so closely resembles superficially. He states: "All the symptoms taken together give the disease a physiognomy which differs from the one of malignant tumors. The extreme hardness, its regularity of surface, its marked diffuseness of limits, the involvement of the gland *in toto* will remind one more of a woody thyroiditis than of a cancer of the thyroid, especially if the disease is found in a young individual, and if it has developed rapidly, and caused early dyspneic symptoms,

entirely out of proportion to the size of the tumor." Crotti states that the surgical treatment of woody thyroiditis is extremely dangerous, and quotes Silatschek and Barjon as stating that roentgen treatment seems to be a specific for the disease.

An interesting side-light is thrown on Riedel's struma in an article by Caldwell entitled "Lymphoid Hyperplasia in the Thyroid Gland," which is abstracted in this issue of the journal (page 510). Caldwell has been impressed by the relatively frequent occurrence of lymphoid hyperplasia as an outstanding change in thyroids removed surgically. He regards such a change as the initial process in Riedel's struma. He has observed it in twenty-nine cases but only three of the glands contained a sufficient amount of dense fibrous tissue to give the characteristics of a woody thyroiditis or typical Riedel's struma. His article merits the attention of all who are interested in thyroid pathology.

Thomas A. Groover.

PATHOLOGY—THE FOUNDATION OF MEDICINE AND SURGERY

The receipt of a new book on pathology has again directed our attention to the fundamental importance of this subject. The book is entitled "Surgical Pathology" and the author is William Boyd, Professor of Pathology at the University of Manitoba. A review will be found on page 491 of this issue of the Journal.

In the Foreword to this book Dr. William Mayo says, "The pioneer pathologists of the past generation laid a foundation for the science of pathology which was very important, but their knowledge of pathologic conditions was acquired largely from the post-mortem room. Even specimens removed at biopsy were cadaverized before they were submitted to microscopic examination. Today pathology is a science dealing with living things and conditions. It furnishes a groundwork of knowledge which facilitates early diagnosis of disease in the living, and its cure by scientific methods."

The author in the initial chapter makes the following statement: "It is true that the embryo surgeon of to-day does not always admit that the road to success must lead through the study of pathology. He may be tempted to turn away with a gesture of intellectual fatigue from the tiresome details of morbid anatomy and histology which can only be mastered by years of labor. To learn technic is easy, but to acquire judgment, based so largely as it must be on pathological knowledge, is a very different matter. He who prides himself on being a practical surgeon may be 'ever learning, and never able to come to a knowledge of the truth.' Such an one is given to peruse the statistics of end results, bristling with sources of fallacy, instead of looking to pathology for guidance in the difficult art of practice. A first-hand knowledge of pathology is the only safe guide for the hands of the surgeon, however skilled those hands may be."

Such a statement is true not only for the surgeon but is especially applicable to the roentgenologist. We who are dealing in our diagnostic work with images on screen or film must constantly have our attention directed to the underlying realities which condition such images. It is axiomatic that our interpretation of roentgen findings is valuable only when it is based on a sound knowledge of anatomy and pathology.

Dr. Boyd's book is unusual because it makes a very successful attempt to relate pathological conditions to the problems of diagnosis and treatment. We especially recommend it to roentgenologists for whom we think it will be valuable for constant daily reference.

CHANGE OF TITLE FROM PROFESSOR OF ROENTGENOLOGY TO PROFESSOR OF BIO-PHYSICS

The Journal is informed by letter dated April 14, 1925, from the President of the University of Illinois that the title of Dr. Albert Bachem, recently appointed Professor of Roentgenology, has been changed to Professor of Bio-Physics. This is in

accord with our suggestion in a letter to the Acting Dean of the Medical College of the University of Illinois published on page 378 of the April issue.

This action will be highly gratifying to all who look upon roentgenology as a department of clinical medicine, and is at the same time a fine commentary on the high standards of those in authority in a great institution that they so promptly rectified a mistake when it was brought to their attention.

Additional action was also taken in the appointment of Dr. Adolph Hartung as Professor of Radiology. This arrangement would seem to be ideal, not only for the teaching of clinical radiology and its fundamental physical and biological bases but also for carrying forward the research work in which every great medical institution should be interested.

THE LEONARD PRIZE

The American Roentgen Ray Society is again offering the Leonard Prize in 1925, and details appear on advertising page i of this number of the JOURNAL. The manuscripts submitted for the previous prize were of a high order of merit and covered a variety of subjects pertinent to roentgenology. It is to be hoped that the contestants for the next prize will be equally zealous in their efforts.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL (*69 East 59th Street, New York*) *their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

THE PHILADELPHIA ROENTGEN RAY SOCIETY

REPORT OF MEETING

THE regular monthly meeting of the Philadelphia Roentgen Ray Society was held on Thursday evening, March 5, 1925, at the Pennsylvania Hospital.

The Scientific Program was as follows: "The Dangers in X-Ray Work and How to Avoid Them." An abstract of the informal discussion is given below. The meeting was well attended, there being fifty-five members and guests present.

Dr. G. E. Pfahler first called attention to the fact that many of the younger workers are probably oblivious of the dangers involved, yet the older men throughout the country are growing more fearful. He presented two letters, one requesting advice received from one of the older roentgenologists with regard to notices to be handed to each patient, calling attention to the dangers of adding local applications, and another calling attention to the fact that one of the insurance companies has now refused to assume the responsibility for any physician who refers a patient for treatment, in case damages result to the patient, and the physician is either sued separately or jointly with the roentgenologist for any damage that may result. This, together with Mr. Whiteside's excellent discussion before the recent meeting of the Eastern Section of the Society, illustrates the growing dangers involved.

The dangers are of three classes:

(1) *Electrical.* In the early days, the output of a coil could be taken with only a moderate amount of shock by either the patient or the operator and no serious danger was involved. Today, with the use of powerful high tension transformers, the autotransformer and the high voltage machines, a stray spark or accidental contact with the high tension current may produce instant death, as has occurred in a number of instances. Therefore, it behooves everyone to be quite sure that every precaution is taken for the proper insulation, and in so far as is humanly possible, to make it impossible for a patient or the operator to come in contact with the high tension wires during an exposure or treatment. Towards this end it is advisable to select experienced men to make installations. Home-made equipment or the installation by a physician himself may result in overlooking some of these important factors.

(2) *Dangers from Over-dosage.* This may involve a single over-dose, such as would occur from the omission of a filter, from over-timing or from a mistake in measuring the distance, because the dose varies inversely with the square of the distance. Therefore, if the distance is shortened by half, the dosage is multiplied by four.

An over-sight may occur from repetitions, in which the accumulated dose is greater than the tissues can stand. This may result in acute dermatitis or in late secondary degeneration.

To avoid this, accurate dosage is absolutely essential and accurate measurements must be made continually. The biological values of the dosage must be understood and therefore should only be directed by an experienced roentgenologist.

If one is so cautious as to under-dose the patient, the patient will then likely die of the disease for which treatment is given, and while this may not involve a law suit, it is clearly a moral responsibility.

The dangers of over-sights as applied to high voltage treatment, unless a filter is omitted, may not affect the skin but may affect the deeper tissues, because of faulty cross-firing, and a larger dosage may be given to the subcutaneous tissue than is given to the skin. This may result in deep-seated necrosis, which may give a local abscess or may give rise to a toxemia.

Over-sights in deep therapy may occur, also, as a result of damage to the blood or essential organs. Therefore, the greatest caution and consideration must be given to each dose as it is set up, and accurate calculation from a medical standpoint, as well as a physical standpoint, must be made.

There is another danger from over-sight which involves particularly the roentgenologist's protection. These damages affected particularly the skin in the early days. Today, with our deeper radiation, there is greater danger from constitutional effects, particularly the effects upon the blood, and toward this end I would advise a study of the blood, involving a careful differential count from time to time. Leucopenia and lymphocytosis are particularly suggestive. In this connection, it must be borne in mind that a leucopenia and a lymphocytosis are also indicative of focal infection. Therefore, when such blood records are found, focal infection must first of all be carefully eliminated before it can be concluded that radiation is the cause. The carrying of a dental film in the pocket for a period of two weeks has been recommended in this connection to determine whether there has been, during this time, any marked fogging. If so, further precaution should be taken to eliminate direct or secondary radiation.

(3) The third group of dangers is that of being held responsible for some coincidental development. There are many illustrations of such actions, and in fact, every roentgenologist knows that whatever happens following roentgen treatment or a roentgen examination is apt to be accredited, by the physician or others, to the roentgen ray, yet may have no connection. Toward this end it is especially important to make accurate records of previous history, illness, etc.

The following rules are posted in Dr. Pfahler's office and in the laboratories in which he is working:

RULES FOR ROENTGEN TREATMENT CASES

1. Record history completely. Inquire as to previous x-ray examinations or treatment.

2. Describe the conditions to be treated.

3. Treatments must be directed by the physician in charge of the x-ray department.

4. After the patient is set up for treatment, the filters and the target skin distance shall be inspected by two people.

5. A time clock shall be set to guard the period of treatment.

6. All protecting devices shall be properly adjusted and the patient must be cautioned not to move.

7. Visitors are not allowed in the treatment room.

8. The operator shall watch the switch, the patient and the apparatus continuously during treatment.

9. Each patient shall be given the prescription for the zinc oxide lotion, to be applied to the skin over the area treated, at least twice daily.

10. Each patient shall be given the caution slip, to guard against the application of irritating agents.

11. After the treatment, the patient shall be told definitely when to return for the next treatment, or inspection, and such appointment shall be entered on the patient's card.

12. Each patient shall be cautioned to keep bowels regular.

13. Each patient shall be requested to drink plenty of water, at least six glasses a day, preferably, orangeade, or lemonade.

14. Any questions concerning the treatment, or its effects, should be discussed directly with the physician in charge.

15. The condition of the patient shall be noted at each visit.

16. No further treatment within four weeks.

The following notice is handed to each patient at the first visit for treatment:

"After patients have had *x*-ray or radium treatment they should apply once or twice daily the special lotion which we prescribe. They should apply nothing else over the areas treated.

Patients should not apply mustard plaster, ice bags, hot water bags, tincture of iodine, chrysarobin, pyrogallic acid, salicylic acid, scarlet-red ointment, analgesic, liniment, ultra-violet light, sunburn, or anything that may cause local irritation."

GEORGE E. PFAHLER, M.D.

The following prescription is given to the patient, with the direction that the lotion shall be applied at least twice daily over the area affected.

Pulv. Zinc Ox.	Dr.	4
Glycerin	Fl. dr.	1
Phenol.	M.	30
Aq. Calcis (fresh) . .	Fl. oz.	8

Sig: Apply locally with a cotton sponge.

G. E. PFAHLER, M.D.

Dr. Pancoast, in his discussion called attention to the danger of over-exposure of the skin from excessive diagnostic exposure in patients previously examined elsewhere within a comparatively short time. This applies especially to sinus, dental, spine, hip and gastrointestinal examinations, and the urinary tract in stout individuals. Sinus, dental and gastro-intestinal examinations had best not be repeated in less than three or four weeks, and in the others we should follow this rule unless assured that the combined previous and necessary present exposure is within the limits of an erythema dose, being sure, of course, that the previous examiner used a filter. Someone in his department is always made responsible for information concerning the time and extent of previous examinations in every patient who comes in for examination. It should be borne in mind that many dental roentgen-ray outfits are not provided with filters.

Before any extensive examination every patient's skin should be carefully inspected for any signs of irritation from hot water bags, iodine or other irritants.

Have a permanent filter placed between tube and patient in all roentgenographic and roentgenoscopic outfits.

Add up the probable total roentgenographic exposures over one area if possible and compare with the results of Dr. Erskine's experiments, making necessary computations for distance.

ABSTRACT OF PAPER BY DR. ARTHUR W. ERSKINE OF CEDAR RAPIDS, IOWA

Minimum Erythema Dose with Roentgenographic exposure:

Coolidge Tube
60,000 Volts
Target Skin Distance 10 inches.

Estimated Minimum Erythema Dose:

Without filter. . . . . 800 ma-sec.
With 1 mm. Al. . . 1800 ma-sec.

Actual Experiments showed Minimum Erythema Dose:

Without filter. . . . . 400 ma-sec.
With 1 mm. Al filter. . 800 ma-sec.

We invariably refuse to treat patients who have been treated elsewhere if we feel assured that the previous treatment has been carried out by a competent man. The one exception is in the case of patients coming from a distance. Under such circumstances, however, we do not begin any treatment without first communicating with the one who previously administered the treatment to ascertain the exact dates and dosage and areas treated. If we treat patients coming from a distance and they are compelled to return home for further treatment, we send similar data directly to the roentgenologist who will carry on the treatment subsequently.

Discourage as much as possible patients travelling through the country and receiving treatment from various individuals during their travels.

Caution is recommended in the treatment of bad thymus cases. In young infants in an alarming condition it may be unsafe to tie or fasten them down for roentgen treatment. In such cases radium treatment is much safer, and preferably by the pack, if possible.

Be most careful in taking histories, and recording all details of treatment, instructions, precautions, advice and prescriptions given patients. Make records of the condition for which treatment is given and condition of skin at each treatment.

Dr. Willis F. Manges discussed particularly the dangers to operators. He recommended constant care in the handling of the apparatus which should be as simple as possible. The apparatus should be properly installed.

In guarding against over exposure particularly in the roentgenoscope, Dr. Manges suggested the use of dark glasses when not in the dark room, in order to keep the eyes constantly accommodated to the darkness, thereby preventing the loss of

time, and also the using of more current than is necessary.

Dr. Jay F. Schamberg in his discussion dwelt particularly on the prevention and treatment of roentgen dermatitis. He stressed the fact that there were certain dermatological conditions that do not respond to roentgen therapy during certain stages of the disease. In these stages one should be very careful in giving roentgen-ray exposures. He has found the use of paraffin fixed dressing such as "ambrine" of great benefit in the treatment of roentgen dermatitis.

Dr. J. D. Morgan discussed fractional dosage as given in the following paper:

"I am fully in accord with what the previous speakers have said relative to the methods of protection necessary when using roentgen-ray apparatus, whether the dangers be from the high voltage electricity or from the rays themselves. Referring only to the latter dangers, I wish to point out one factor of safety which has been entirely overlooked so far this evening, namely that of reduced dosage. All the safety factors suggested have been based on the supposition that large, or moderately large, doses are under consideration. Of course, if these large doses are necessary for the ultimate good of the patient we must continue to use them, and, while so doing, to take every precaution possible to protect our patient. However, many radiologists now believe that large doses are not only unnecessary but even harmful as damage is done to the healthy cells as well as to the diseased cells. We have, consequently, reduced our dosage very considerably. For over a year I have been using a very much reduced fractional radiation dosage, and I am becoming all the more favorably impressed with it as I gain experience in its results. I will not now enter into a discussion of the technique, as that is not the purpose of this meeting, but will just mention that my dosage consists of exposures of three, five and ten minutes, twice daily, during two or three weeks, depending on the conditions present, and the location of the neoplasm. A number of older, and more experienced, radiologists have criticised this on the grounds that it was tried out fifteen or twenty years ago, and that there has not yet elapsed sufficient time in which to draw final conclusions relative to the cases which I have treated, I would respectfully call attention to the fact that at the time when these earlier cases were treated there were no high voltage transformers and no heavy screening, and, consequently, no homogeneous deeply penetrating rays with their resulting 'scattered' radiations which have such an important action on the diseased tissues. I cannot feel, therefore, that too close a comparison can, in fairness, be made between these methods, and that we must wait for sufficient time to pass before drawing final conclusions as to the value of this newer technique. It can be definitely stated, however, that the immediate effects are of remarkable interest and are even startling, in the good results which they show.

"But, to return to our original theme, this technique practically does away with a number of the dangers of roentgen radiation experienced when using heavy dosage. For example, since employing this technique I have not yet seen a typical skin erythema, although some cases have received, during their several series, two or three 'erythema doses' over certain areas. The skin graudally becomes tanned, sometimes deeply so, without, however, the appearance of erythema, blistering, or other unpleasant sequelae. Nor is it necessary, with this technique, to worry whether portals of entry overlap. I have never experienced any bad effects from this. Roentgen sickness is done away with. Of course it is necessary, even with this method, to make sure that the proper filters are in place; but, if they should by chance be omitted, nothing like the harm will be done as when filters are forgotten while using heavy dosage. We have one of Mr. Weatherwax's ionization chambers over the end of the treatment cone during the whole of the exposure so that a check is maintained on the output of the tube and on the proper filtration of the rays."

Mr. James Weatherwax described the galvanometer and ionization chamber, as adopted by him for the prevention of

omitting filters. The apparatus is attached directly to the tube stand. He also warned against the use of open lead bowls for high voltage therapy.

Following the scientific program, a short business session was held after which the meeting was adjourned.

Eugene P. Pendergrass,
Secretary.

ARRANGEMENTS OF PROTECTION IN ROENTGEN AND RADIUM WORK

EDITOR'S NOTE: The following article is reprinted by permission from *Acta Radiologica*, 1924, iii, 442–445, in order to inform our readers of the means of protection now being recommended in other countries.

SUGGESTED BY THE PROTECTION COMMITTEE OF "NORSK FORENING FOR MEDICINSK RADIOLOGI"

At a meeting of "Norsk forening for medicinsk radiologi" on the 16th of May, 1922, a committee was appointed consisting of the following 5 subscribing members. The committee was commissioned to draw up suggestions for regulations with regard to arrangements for protection against the perils and deleterious influence on health, to which patients, medical men and nurses may be liable owing to their work and stay at roentgen and radium institutes.

The return of the committee is more exactly specified in the following points:

1. To formulate necessary protective arrangements against the *noxious effects from roentgen and radium rays* in roentgen and radium medical institutes and in other institutes where roentgen and radium rays are administered.

2. To formulate necessary protective arrangements against *other noxious effects* in roentgen institutes, as electric discharges from high-tension circuits, detrimental gases, and explosion of roentgen tubes.

3. To formulate distinct working conditions for the personnel engaged in roentgen and radium institutes, with the view to protecting them against the effects of the noxious rays and preserving their health.

4. To formulate a regulation for protective arrangements particularly against the noxious effects of the roentgen and radium rays on the patients.

In dealing with points 1 and 2 there are 4 facts to be taken into consideration, viz.—the roentgen and radium rays, the gases developed in the roentgen room, the high-tensioned current and the eventual explosion of roentgen tubes.

The danger incurred through the roentgen rays and the dwelling in roentgen rooms has been partly known from the time of the discovery of the rays, but has constantly increased as the apparatuses have become more perfect and powerful, the high tension increased, and the rays more penetrating. *As to the radium rays, the peril has increased with the quantity of radium employed* and its *varied application* (needle-treatment, emanation-treatment.)

These rays have more and more attracted attention, and some deaths amongst roentgenologists, roentgen nurses, *radiologists, and their assistants* due entirely to their work with the rays, have stirred up the minds and given rise to demands of some regulation for protective measures.

This has also resulted in the question having been taken up in most civilized countries, and rules for protective measures against these rays are being drawn up in England, France, Germany, and the United States.

The roentgen and radium rays act partly through the rays emanating direct from roentgen and radium tubes and partly through reflected—secondary—rays. These latter ones are reflected from the walls, ceiling, and floor, and from all objects in the roentgen and radium room.

The human structures which are injured by the action of the rays are particularly the skin, the genitals, and the blood-producing organs. The diseases which they give rise to are atrophy and other diseases of the skin (the roentgen and radium dermatitis and its sequelae), sterility, cancer, and deadly diseases of the blood.

The gases developed in the roentgen room are ozone and nitrous gases. They are developed by radiation from the high-tension currents and by sparks in

the apparatus; they produce an anaemic condition which manifests itself as a feeling of indisposition, nausea, headache, etc.

The danger of the *high-tension circuit* is greater in the roentgen room than in the case of other installations. For certain peculiar reasons, the circuit cannot be insulated, and must be placed so far down that contact may easily happen. *Deaths have occurred through contact with high-tension circuit in the roentgen room.*

The explosion of roentgen tubes may occur through unskilled and incautious handling. Splinters of glass are hurled about in all directions with tremendous force by the explosion. If the explosion happens during a seance (roentgen treatment or roentgenography), the red-hot anticathode might fall down and cause serious burns.

These are briefly the dangers menacing everybody who has anything to do with the roentgen and radium rays.

But even *patients* who for curative purposes are exposed to these rays may be liable to injuries which, in their gravest form may cause death or permanent invalidity, when the treatment is undertaken and administered by ignorant individuals.

Before submitting their suggestion for regulations, the members of the committee want to call attention to a condition that ought to be amended. According to Norwegian legislature, any citizen has the right to set up a roentgen or radium institute and to administer treatment with roentgen and radium.

No training, no knowledge of a roentgen apparatus or of the effects of the roentgen and the radium rays are necessary to be allowed to administer a treatment that may endanger human life.

With regard to the physicians, the fact is that the training in radiology is not obligatory, and the majority of the physicians leave our university without any knowledge of roentgenology and radium therapy and only with the vague knowledge of the interpretation of roentgenograms that is occasionally imparted at the clinics.

And, in spite of this fact these same men are later on in life authorized to manage a roentgen institute in their capacity of physicians at a hospital.

With regard to this fact, the committee considers that a reform ought to be inaugurated.

Nobody should be permitted to administer roentgen rays or radium to patients, without having the necessary training.

THE PROPOSITION OF THE COMMITTEE

1. Protective Arrangements in Roentgen Institutes

1. *The roentgen room* should be well ventilated and have a floor-space of not less than 20 sq. meters and a height of not less than 3 meters; it should not be situated underground. The floor should be covered with wood, linoleum, cork, or some other similar insulating material.

2. *The high-tension circuit.* Provided that the high-tension wires have to be drawn through the room, they must be placed at a height of at least 2½ meters from the floor. Moreover, the distance from the ceiling should be at least ½ meter. For insulating tubes bright-polished metalpipes should be employed.

3. A *separate box for the operator* should be fitted up in the roentgen room—its walls, ceiling, and door to be covered with at least 2 mm. lead when the operator is diagnosing—and with at least 3 mm. lead during treatments, or with some other equally efficient protective material. The room should be provided with a window of lead-glass of corresponding thickness.

4. As far as therapy with strong penetrating radiation is concerned, the rays must be prevented by sufficient screening from penetrating into adjoining rooms, where they might do harm.

5. *The roentgen tube* should as far as possible be enclosed in a lead-covered box or in any other protective material corresponding to 2 mm. lead.

6. Apparatus, roentgen tubes, and fluoroscopic stands should be provided with ground conductors.

7. The *fluorescent screen* should be covered with lead-glass, its thickness corresponding to 2 mm. lead of protective quality, and the screen should be so big,

as to cover the whole of the radiated area when the diaphragm is quite open.

8. Lead-gloves and an apron of lead-rubber or some other protective material are recommended to be worn always in roentgenoscopic work.

9. In *Roentgen Deep Therapy* or in other protracted roentgen treatment it is to be recommended to cover the patient wholly—except the irradiated part—with lead-rubber or any other protective material corresponding to 1 mm. lead.

10. A plate of asbestos should be placed between the *roentgen tube* and the *metal filter* so as to prevent the dangerous effects of a possible explosion of the roentgen tube.

Roentgen diagnosis and *roentgen therapy* should not be carried on simultaneously in the same room, and no outsiders should be allowed in the room when the work is going on.

Sections 3, 5 and 9 may be disregarded when the roentgen tubes are walled in and high-tensioned in lead chambers are used.

II. Protective Arrangements at Radium Institutes and in Rooms where Concentrated Radium Preparations Are Used

Radium which is not in use should be kept safe in a cupboard with impenetrable walls, their thickness corresponding to not less than 8 cm. lead.

While packing radium preparations for medical purposes, the operator's body should be protected by a leaden-wall 3 cm. thick, and the fingers of the operator should come as little as possible in direct contact with the radium preparations.

During the employment of radium emanation, the room in which the emanation is produced should be ventilated with electric fans (or by some other means) and the operator ought to protect himself as much as possible against the dangerous rays. The personnel of the institutes are recommended to have their blood examined at regular intervals, at least once a year.

The committee proposes that the observance of these regulations be controlled in the following manner: A controlling physician is nominated for the whole country, who is also to act as consultant to the Board of Medical Directors.

Plans for all roentgen and radium installations are in the first instance to be submitted to and considered by the controlling physician, and are then sent to the Board of Medical Directors for approval.

Before a new installation is taken into use it must be approved of by a technical expert.

III. Working Conditions for the Physicians of the Institutes and the Nurses

1. Physicians appointed for the time of a year and more and the nurses should have 6 weeks vacation—of which 4 weeks in the summer and 2 weeks in the winter.

2. Eight hours work a day in the roentgen room should be maximum. Nurses who are occupied exclusively with therapeutic work, should have a maximum working time of 6 hours.

3. Nurses should have a whole day and 2 afternoons off in the week.

IV. Protective Arrangements Especially with Regard to the Harmful Effects of the Roentgen and Radium Rays on Patients

A. The quackery law of 1889 should be amended to the effect that quacks ought to be quite forbidden to employ roentgen or radium rays—neither for roentgenographic or roentgenoscopic examinations, nor for treatment of patients.

B. *Obligatory training in roentgenology for medical and dental students.*

Before being allowed to enter for his final examination, the student should have had 2 *months* practical and *theoretical* training at a roentgen institute authorized by the Government.

C. This should also apply to qualified men. A similar qualification should be stipulated for dental students, in correspondence with their particular requirements.

Finally, the committee would remark that the demands drawn up *apply only to the medical radiology.*

Besides in medicine, the radiology is also applied, as is well known, both

technically and in other branches of science.

The committee would consider it unpractical to lay down uniform regulations for all these branches. The committee is however of the opinion that these regulations might also serve *as a rule for the other branches of science.*

Nor can the same rules be laid down for all eventualities in medical radiology. A certain distinction must be made between roentgen and radium *institutes* managed by hospitals or private people and such instances where a physician or a dentist, beside their customary practice, use a roentgen-apparatus for diagnostic purposes without any *assistant.*

Our proposition is proffered with a view to roentgen and radium institutes; though *it is applicable in every instance where an assistant is employed.*

As to the physicians and dentists who only occasionally use a roentgen apparatus without the aid of an assistant, the committee is of the opinion that their license is a sufficient guarantee that proper work is being done—provided they have got the training proposed by the committee.

P. AMUNDSEN, E. BERLE, ELLEN GLEDITSCH, S. A. HEYERDAHL, L. VEGARD

MEETINGS OF ROENTGEN SOCIETIES

We contemplate the publication of a list of roentgen society meetings such as that below, in each issue of the Journal, gradually adding other home and foreign societies as the information reaches us. Secretaries of societies not here listed are requested to send the necessary information to the editor.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. Eugene V. Powell, 217 East 42d St.
Meets monthly on second Monday, New York Academy of Medicine.

THE CANADIAN RADIOLOGICAL SOCIETY
Secretary, Dr. E. C. Brooks, Montreal.
Annual meeting, Regina, Sask., June 22–26, 1925.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

THE NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Frank E. Wheatley, 520 Beacon St., Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Eugene Pendergrass, University of Pennsylvania, Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. Edward S. Blaine, 2005 S. Wabash Ave.
Meets monthly on second Friday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. R. G. Van Nuys, San Francisco.
Two meetings a year.
Coming meeting at Hotel Oakland, Oakland, Calif., July 9, 10 and 11, 1925.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. E. P. McNamee.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. C. J. McCullough, Decatur, Illinois.
Regular meetings held quarterly.

SOCIETA ITALIANA RADIOLOGIA MEDICA
Secretary, Professor M. Ponzio, University of Torino, Torino.
Sixth Congress of this Society will take place at Trieste, May 7–10, 1925, under the presidency of Professor Gortan.

THE BRITISH RÖNTGEN SOCIETY
Meets on the first Tuesday of each month from November to June inclusive, at 8.15 P.M., at the British Institute of Radiology, 32 Welbeck St., London, W. 1.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)
Meets on the third Friday of each month during the winter at 8.30 P.M. at the Royal Society of Medcine, 1 Wimpole St., London, W. 1.

BRITISH INSTITUTE OF RADIOLOGY
Secretary, Dr. John Muir, 32 Welbeck St., London, W. 1.
Meets at 32 Welbeck St., but regular dates and times of meeting have not yet been arranged.

SCANDINAVIAN ROENTGEN SOCIETIES
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies meets every second month except in the summertime:
Society of Medical Radiology of Sweden
Meets in Stockholm.
Society of Medical Radiology of Norway
Meets in Oslo.
Society of Medical Radiology of Denmark
Meets in Copenhagen.
Society of Medical Radiology of Finland
Meets in Helsingfors.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY
Meets in Amsterdam every second month except in the summertime.

COMING MEETING

WESTERN SECTION AND PACIFIC COAST ROENTGEN RAY SOCIETY

The combined meeting of the Western Section, American Roentgen Ray Society, and the Pacific Coast Roentgen Ray Society will be held in Oakland, California, July 9, 10 and 11 at the Hotel Oakland. A cordial invitation is extended to all who are interested in roentgenology to attend this meeting. Further information concerning the meeting may be obtained from the secretary of the Pacific Coast Roentgen Ray Society, Dr. R. G. Van Nuys, 434 Oakland Bank Bldg., Oakland, California.

PROPAGANDA FOR REFORM

To the Editor: Any move relative to "Propaganda and Reform" whether it be concerning the medical profession or the K. K. K. should be undertaken in a careful manner for there is always the possibility of doing as much harm as good.

I admit that there are a good many X-Ray technicians which have no business even making an examination let alone to give a physician an interpretation of the findings and if your committee in charge of this investigation of "The practice of Roentgenology by laymen" can in any way curb that type of technicians it will be a blessing to the whole profession. But please do not take the attitude that because a technician does not hold the degree of M.D. he is ignorant of the science of Roentgenology.

True a man who has had the advantage of a complete course in medicine should be in a better position to describe his radiographic findings both from the stand point of anatomy and pathology to a better advantage than the man who has not had these advantages. Yet a large percentage of the physicians of today have forgotten 50 per cent of the anatomy they were taught in school while the X-Ray technician who is trying to be of a real assistance to the attending physician keeps constantly in touch with his text books and is in a better position to correctly name an anatomic part than the man who graduated from medical school ten or more years ago.

I have been doing X-Ray and clinical laboratory work for the past eight years and when I make the statement that if you try to remove all the technicians from a X-Ray laboratory where they have proven to the attending physicians that they can produce the goods and are entitled to the right to have complete charge of the department you will be doing an atrocious injustice. For the M.D. signed after many a man's name really only means (More Dignity).

Hoping that I may have the privilege to seeing this in an early edition and that it will be taken as meant and not as it may sound.

Sincerely yours,
(Signed) B. M. GOLDEN.
Indianapolis, Ind.

Editor's Note: The above letter is published because we believe that it represents the honest opinion, not only of the writer, but of a considerable number of conscientious laymen who are doing good technical work in the field of roentgenology.

It is, of course, admitted by all who are acquainted with roentgenological work in this country and who have given the subject considered thought, that there are men without medical degrees who are doing creditable work as roentgenologists. Some of these men are of high character and fine ability, and they have won the respect of us all. This is very far, however, from admitting that it is a safe general rule to entrust the practice of a medical specialty to men lacking in fundamental medical training.

Our correspondent himself states that "a man who has had the advantage of a complete course in medicine should be in a better position to describe his radiographic findings both from the standpoint of anatomy and pathology than the man who has not had these advantages." His further argument that the possession of the degree of M.D. does not of itself make a man a roentgenologist is admitted by everybody. This Journal holds no brief for the untrained roentgenologist even though he may have a half dozen degrees, including that of M.D. Our entire contention is that the broad medical tra'ning which includes not only pathology and anatomy but

materia medica, pharmacology, therapeutics, physiology, surgery, internal medicine, and many other studies and which finally entitles a man to the degree of Doctor of Medicine is the only proper *foundation* for the study of roentgenology, just as it is the only foundation for the practice of surgery or any other specialty.

We have no intention of doing an injustice to any man or group of men but we are convinced that roentgenology has passed the pioneer stage when it could rightly be practiced by men who had attained their medical knowledge in an incomplete and haphazard way. We conceive it to be one of the duties of this Journal to use all of its influence to elevate the standards for the practice of roentgenology. We are convinced that the attainment of the degree of M.D. is not too much to ask of any man who is to assume the great responsibilities entailed when he uses the roentgen ray for the diagnosis and treatment of disease. We think that M.D. may mean not only "more dignity" as our correspondent suggests, but also "more drill," more discipline," "more development," "more dependability" and many another "more" that his training has given him above his untrained brother.

We confidently look forward to the time when the medical practice acts will be so amended that the practice of roentgenology will be plainly described as "the practice of medicine." It is only so that legal restraints and safeguards can be placed about the use of this agent with its immense potentialities for harm as well as good.

AMERICAN RADIUM SOCIETY

TENTH ANNUAL MEETING

CHALFONTE-HADDON HALL, ATLANTIC CITY, N. J.

MONDAY AND TUESDAY, MAY 25TH AND 26TH, 1925

PROGRAM

MONDAY MORNING, MAY 25TH, 1925, 9 A.M.

BUSINESS SESSION

"Radium Radiation from a General Utility Standpoint." ALBERT SOILAND, M.D., Los Angeles, Cal. Discussion by: R. E. LOUCKS, M.D., Detroit, Mich. ROBERT P. WADHAMS, M.D., New York, N. Y.

"The Use of Radium in Inoperable Carcinoma of the Cervix." C. D. BROOKS, M.D., Detroit, Mich.

"Carcinoma of the Cervix, Evaluation of Treatment with Radium." WILLIAM P. HEALY, M.D., New York, N. Y. Discussion by: HENRY SCHMITZ, M.D., Chicago, Ill., E. C. SAMUEL, M.D., New Orleans, La., JAMES A. CORSCADEN, M.D., New York, N. Y., JAMES T. CASE, M.D., Battle Creek, Mich.

"Carcinoma of the Ovaries, Its Treatment with Radium, Surgery and the X-rays." HENRY SCHMITZ, M.D., Chicago Ill. Discussion by: LEDA J. STACEY, M.D., Rochester Minn., WM. S. STONE, M.D., New York, N. Y., WM. P. HEALY, M.D., New York, N. Y.

"The Selective Treatment of Fibro Myoma." JAMES A. CORSCADEN, M.D., New York, N. Y. Discussion by: WM. S. STONE, M.D., New York, N. Y., JAMES T. CASE, M.D., Battle Creek, Mich.

MONDAY AFTERNOON, MAY 25, 1925, 2 P.M.

BUSINESS SESSION

"The Sutureless Open Operation for Malignancy. A Necessity for Efficient Post-Operative Radiation." EMIL G. BECK, M.D., Chicago, Ill. Discussion by: HENRY SCHMITZ, M.D., Chicago, Ill., C. D. BROOKS, M.D., Detroit, Mich.

"Radio-Resistant Carcinomas." SANFORD M. WITHERS, M.D., Denver, Colo. Discussion by: B. F. SCHREINER, M.D., Buffalo, N. Y., H. N. COLE, M.D., Cleveland, Ohio.

"The Limitations of Radium Therapy in Dermatology." LAWRENCE R. TAUSSIG, M.D., San Francisco, Cal. Discussion by: H. N. COLE, M.D., Cleveland, Ohio, NATHAN T. BEERS, M.D., Brooklyn, N. Y., FRANK E. SIMPSON, M.D., Chicago, Ill.

"On the Differential Action of Beta Radiation." GIOACHINO FAILLA, E.E., D. SC., New York, N. Y. Discussion by: CHARLES H. VIOL, M.D., PH. D., Pittsburgh, Pa., A. WEATHERWAX, M.A., Philadelphia, Pa.

"Protection to Technical Assistants and Those Handling Large Quantities of Radium." CHARLES H. VIOL, M.D., PH. D. Pittsburgh, Pa., GEO. E. PFAHLER, M.D., Philadelphia, Pa., A. WEATHERWAX, M.A., Philadelphia, Pa., GIOACHINO FAILLA, E.E., D. SC., New York, N. Y.

"A Preliminary Report on the Use of an Absorbable Filter with Bare Tubes of Radium Emanation." ARTHUR C. HEUBLEIN, M.D., Hartford, Conn. Discussion by: HENRY K. PANCOAST, M.A., Philadelphia, Pa., CHARLES H. VIOL, M.D., PH. D., Pittsburgh, Pa.

MONDAY EVENING, MAY 25, 1925, 8 P.M.

Annual Dinner (Arranged by W. S. NEWCOMET M.D., and W. C. WESCOTT, M.D., PH. G.).

TUESDAY MORNING, MAY 26, 1925, 9 A.M.

BUSINESS SESSION

"The Treatment of Epithelioma of the Penis with Radium and Roentgen Rays." ARCHIE L. DEAN, JR. M.D., (by invitation) New York, N. Y.

"The Influence of Radium Treatment upon the Prognosis of Malignant Tumors of the Testicle." EDWARD L. KEYES, JR., M.D., (by invitation) New York, N. Y. Discussion by: HERMAN C. KRETSCHMER, M.D., Chicago, Ill. BENJAMIN S. BARRINGER, M.D., New York, N. Y., LAWRENCE R. TAUSSIG, M.D., San Francisco, Calif.

"Some Suggestions for Irradiating Recto-Sigmoid Carcinoma." (Illustrated by slides.) JAMES T. CASE, M.D., Battle Creek, Mich. Discussion by: EDWARD H. SKINNER, M.D., Kansas City, Mo., GEO. E. BINKLEY, M.D., (by invitation), New York, N. Y.

"Thyroid Gland Diseases with Radium Treatment in Thryotoxicosis." R. E. LOUCKS, M.D., Detroit, Mich. Discussion by: GEO. GRIER, M.D., Pittsburgh, Pa., SANFORD M. WITHERS, M.D., Denver, Colo.

"Experimental Studies on the Biological Effects of Radium upon Tissues Growing in Vitro." MAURICE J. SITTENFIELD, M.D., New York, N. Y. Discussion by: RAYMOND HUSSEY, M.D., New Haven Conn. JAMES EWING, M.D., New York, N. Y.

TUESDAY AFTERNOON, MAY 26, 1925, 2 P.M.

BUSINESS SESSION

"A Practical Instrument for Inserting Needles of Radium Salt to any Depth." OSCAR L. NORSWORTHY, M.D., Houston, Texas.

"Reactions of Lymphoid Tissue to Radiation." JAMES EWING, M.D., New York, N. Y.

"The Treatment of Intra-Oral Carcinoma by Contact Application of Radium." GEO. W. GRIER, M.D., Pittsburgh, Pa.

"Radium Emanation in the Treatment of Cancer of the Tongue and Other Parts of the Oral Cavity." FRANK E. SIMPSON, M.D., Chicago, Ill. and ROY EMMERTT FLESHER, M.D., (by invitation), Chicago, Ill.

"An Investigation of the Results Obtained in Epithelioma of the Tongue Treated by Radium and X-rays based on a Study of 127 Cases." B. F. SCHREINER, M.D., Buffalo, N. Y.

"Curie Therapy of Epidermoid Carcinoma of the Mouth as Carried Out at the Radium Institute, Paris." MAURICE E. LENZ, M.D., (by invitation), New York, N. Y. Discussion by: JAMES EWING, M.D., New York, N. Y., GEO. E. PFAHLER, M.D., Philadelphia., W. H. CAMERON, M.D., Pittsburgh, Pa., FREDERICK M. JOHNSON, M.D., Atlanta, Ga., ARTHUR C. HEUBLEIN, M.D., Hartford, Conn., G. ALLEN ROBINSON, M.D., New York, N. Y. and ROBERT P. WADHAMS, M.D, New York, N. Y.

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

THE PRECISE ROENTGENOGRAPHY AND MEASUREMENT OF THE OPTIC CANAL*

BY HARRY A. GOALWIN, B.S., M.E., M.D.

Du Bois Fellow of Columbia University
Herman Knapp Memorial Eye Hospital

NEW YORK CITY

THE roentgenography of the optic canal has been of interest to the ophthalmologist, rhinologist, neurologist and roentgenologist for a considerable time. Van der Hoeve,[4,5] de Kleyn and Stenvers,[2] Herrnheiser,[3] White[6] and others have reported as to the normal and pathological details of the form, size, and structure of the walls of the optic canal, as demonstrated in the roentgenogram. The cases published by these authors include fractures of the optic canal walls, constriction of the canals by hyperostoses (Paget), destruction of the canal walls by tumors and, finally, changes in the shape and size of the canals produced by the pneumatic spaces adjacent to them, as the cause of visual disturbances.

In 1923, while working with Professor Artur Schüller of Vienna, I undertook to make an anatomic and roentgen-ray study of the optic canals in oxycephaly and other skull deformities which are usually accompanied by visual disturbances. The main object was to study the mechanical factors in the causation of the visual disturbances in these cases. It appeared to us then, after reviewing the literature, that in developing the technique of optic canal roentgenography three fundamental errors or omissions had been made: In the first place, while far reaching conclusions had been drawn from changes in the shape and size of the optic canals, as measured from the roentgenogram, no data could be found on the *direction of the axis* of the optic canal, without the knowledge of which no really precise roentgenogram of the optic canal can be obtained.

Thus, White,[6] after emphasizing the importance of making the central ray coincide with the optic canal axis, goes on to describe a technique which requires only that the shadow of the optic canal fall within the lower outer quadrant of the orbital outlet. Now, if we take the average distance of the optic canal from the plate as 6.0 cm., and the average diameter of the lower outer quadrant of the orbital outlet as 2.0 cm., this allows a latitude of an angle whose tangent is $\frac{1}{3}$; nearly 20 degrees!

In the second place, the placement of the head for optic canal roentgenography had been described in reference to points on the facial bones, an obviously unscientifi procedure in any cranial roentgenography, which should be superseded by reference to the principal planes of the head, as is practised in anthropology.*

In the third place, no mathematical study has been made of the relation of the actual to the roentgenographic diameters of the optic canals.

It therefore became necessary, before we could continue our problem, to make a study of these factors. With this end in view we undertook a study of the direction, shape and size of the optic canals on the skull material of the anatomical and pathological museums of the University of Vienna, as well as of the skull material of the Viennese Museum of Natural History

* From an article which van der Hoeve[6] published since the reading of this paper we gather that he still uses the Rhese position in his roentgenography of the optic canal. This position was devised by its author primarily for projecting the ethmoid cells on the plate through the orbit. The picture of the optic canal obtained by this method is highly distorted (Fig. 3) and therefore useless for a study of its shape and size, or finer changes in its walls or lumen.

* Read at the Sixth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 22–24, 1925.

and of the neurological clinic of Professor Wagner von Jauregg. The methods and results of this investigation were presented by the author at the Ophthalmological Society of Vienna in March, 1924.[7] As the precise roentgenography of the optic canals and the interpretation of the roentgenograms is dependent upon these results, they will be briefly summarized here: 194 optic canals were studied in 97 skulls. Of these skulls 17 were deformed (oxycephaly, scaphocephaly, plagiocephaly). The remaining skulls were normal and were divided into two groups, one developmental, between the ages of three months and twenty years, and the other adult, from twenty years up.

It was found that the direction of the optic canal in a normal skull varies with the age of the individual, that it deviates considerably from the normal in deformed skulls and that in the normal skull the axis of the optic canal is directed toward the lower outer angle of the orbital margin. The determinations were made by measuring the angle which the plane of the two optic canal axes makes with the horizontal plane of the skull, which we call angle α (Fig. 1), and the angle which the axis of each canal makes with the median plane of the skull, which we call angle β (Fig. 1), the latter being measured in the plane of the optic axes.

These measurements, as well as the average distances of the optic canals from the lower outer angle of the orbital margin, were plotted in the form of curves in which the age of the individual is the abscissa and the corresponding average angles and distances the ordinates. The curves have already been published.[9] They show a variation in the angle α from 28° at birth to 39.9° at and over seventeen years, and in the angle β from 35.5° at birth to 38.3° at and over seventeen years. The average distance from the posterior end of the optic canal to the lower outer angle of orbital margin varies from 4.5 cm. at birth to 5.4 cm. at and over seventeen years. A preliminary report on the application of these data in the roentgenography of the optic canal was presented at the Roentgen Society of Vienna in April, 1924.[8]

It is obvious from the studies we have made that no *one* position can be given which will produce a precise roentgenogram of the optic canal in every case. There are left to us two alternatives. The first of these is difficult but not impossible. It consists of determining roentgenographically the direction of the axes of the optic canals of the patient in question, and using this information in making the placement for the optic canal roentgenograms. The second alternative, which is the one we have chosen, is as follows: The angles α and β are determined from our curves or tables for the age of the patient whose optic canal is to be studied. The

FIG. 1. The capped head, marked and in position for taking roentgenogram of the left optic canal. Vertical arrow shows direction of central ray.

patient's head is then so placed on the plate (Fig. 1) that the horizontal plane makes an angle equal to 90-α with the plate. The optic axes plane is now perpendicular to the plate. Without changing this direction we now rotate the head to the side on which the optic canal is to be studied until the median plane makes an angle equal to 90-β with the plate. The head is now in the proper position. The tube is then centered over the lower outer angle of the orbital margin lying on the plate, and the exposure is made.

The angles should be actually *measured* in every case, *not merely estimated.* For this purpose a soft white muslin cap (Fig. 1) such as the author has devised for use in all his cranial work, is properly fitted on the patient's head, and the principal lines of the head marked on it (the hori-

zontal and median lines). The inclination of the principal planes to the plate can now be measured carefully by means of a protractor. A standard marked cap cannot be used. Each cap is blank to start with, is marked after being fitted tightly on the head, and its marked surface cannot be used even on the same patient after it has been taken off. It can be washed and used again as a blank, for further marking.*

The calculation of the actual diameters of the optic canal from the diameters found on the roentgenogram would be very simple if we could assume that the focal spot of the tube used is a geometrical point. In that event the ratio of the actual to the roentgenographic diameters would be the same as the ratio of their respective distances from the focal spot. But as the diameter of the focal spot may vary from 1.0 mm. to over 10.0 mm., while the average diameter of the optic canal is only 4.3 mm., this is an item which cannot be neglected. Taking this factor into consideration the author has derived the following formula,[8] which gives the relation of the actual to the roentgenographic diameters of the optic canals:

$$x = d - \frac{b}{a}(f + d)$$

where x is the actual diameter of the optic canal, d is the corresponding roentgenographic diameter, b is the distance from the posterior end of the optic canal to the plate, a is the distance of the focal spot from the plate, and f is the diameter of the focal spot of the tube used.

The method of determining the value of f and the mathematical reasoning leading to this equation have been described elsewhere.[8,10]

The distance a is measured at the time of making the roentgenogram, the distance b is obtained from our curves or tables (as it depends on the age of the patient), and the diameter d is measured from the roentgenogram; x then remains the only unknown, and can be determined from the equation. If the same tube is used and its distance from the plate kept constant, a reduction table can be prepared giving x in terms of b only. This can be further simplified by solving for b at values corresponding to various ages. The author has prepared such a reduction table for adults, since these constitute most of the patients referred for optic canal roentgenograms. For patients in the developmental stage he goes through the entire calculation each time. As has been pointed out in our previous writings,[7,9] the cross section of the optic canal is not circular, hence its size cannot be given by stating only one dimension. After stating its shape in terms of the geometrical figure which it approximates we can give its maximum and minimum diameters. The author finds that these two principal diameters are usually situated as follows: The diameter A is directed downward and outward at an angle of about 45°, while the diameter B is directed at right angles to A. The average diameters as determined by our measurements on normal skulls are:

Right: A diameter, 4.26 mm., with a maximum of 5.3 mm., and a minimum of 3.5 mm.; B diameter, 4.33 mm., with a maximum of 5.6 mm., and a minimum of 3.0 mm.

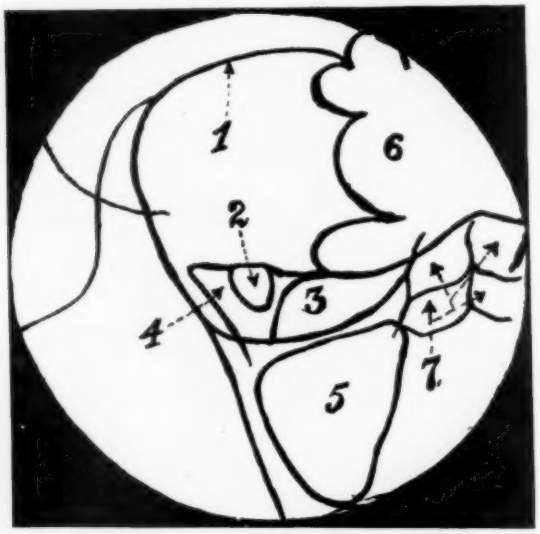

FIG. 2. Sketch showing the structures seen on an optic canal roentgenogram. Orbital margin 1; optic canal 2; sphenoidal sinus 3; spheno-maxillary fissure 4; maxillary sinus 5; frontal sinus 6; ethmoid cells 7.

* Other special devices which the author uses in this work, and which make it just as simple as the roentgenography of the sinuses or sella turcica, have been described in the paper read before the Roentgen Society of Vienna.[8]

Left: *A* diameter, 4.49 mm., with a maximum of 5.6 mm., and a minimum of 3.5 mm.; *B* diameter, 4.30 mm., with a maximum of 5.5 mm., and a minimum of 3.5 mm.

A point of importance in judging whether an optic canal is constricted or not is found in the fact that the optic canal has the adult size and shape at the age of three years, so that we do not expect to find a canal of smaller size in a child than we do in an adult.

Seven structures of importance are recognized on every roentgenogram taken for the optic canal (Fig. 2). These are: (1) the orbital margin; (2) the optic canal, at the lower outer angle of the orbital margin; (3) the sphenoidal sinus, below and mesial to the optic canal; (4) the sphenoidal fissure, below and external to the optic canal; (5) the maxillary sinus, below the inferior orbital margin; (6) the frontal sinus, above and mesial to the sphenoidal sinus; and (7) the ethmoid cells mesial to the sphenoidal sinus.

When pneumatized the anterior clinoid process is recognized external to the optic

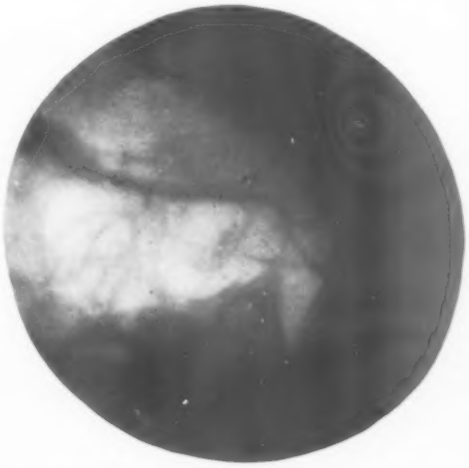

FIG. 3. The optic canal as seen in the Rhese position. Note distortion of shape, particularly narrowing of vertical diameter.

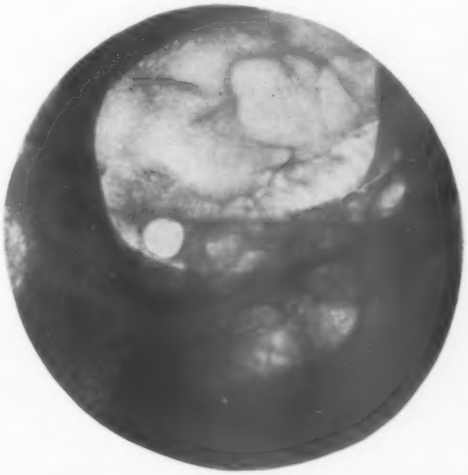

FIG. 4. The optic canal as it appears in the position described by us.

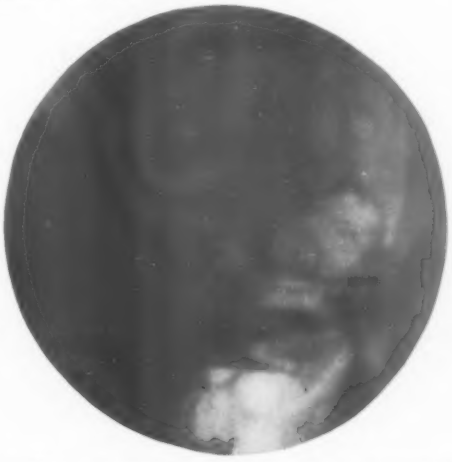

FIG. 5. Roentgenogram showing a large, pneumatized anterior clinoid process on the temporal side of an otherwise normal optic canal. Note the bulging of the wall of the optic canal into its lumen where it is pushed by the air cell.

FIG. 6. Roentgenogram showing destruction of roof of optic canal by a tumor. This is from a case of tumor of the middle fossa with almost complete destruction of the sella turcica, invasion of the frontal region and extension into the posterior fossa. The case will be described in detail in a later paper.

canal (Fig. 5). When calcified the cavernous portion of the internal carotid artery can be recognized.

In reporting upon an investigation of a optic canal the shape, size, structure of its walls (Fig. 6) and of the adjacent structures should be stated.

The clinical value of these roentgenograms will be discussed in detail in a later paper. Briefly stated, they are of value in:

(1) Optic neuritis, retrobulbar neuritis, choke disc, optic nerve atrophy, etc.

(2) Sphenoidal disease with or without optic nerve symptoms.

(3) Orbital, ocular or optic nerve tumors.

(4) Known or suspected fracture of the skull, whether recent or healed.

(5) Foreign body in the orbit.

(6) Skull deformity with visual disturbances.

(7) Tumors of the anterior or middle fossa.

(8) Certain general diseases, like Paget's disease, acromegaly, rickets, etc.

(9) Cases of tuberculosis with optic nerve symptoms.

(10) Medico-legal cases, where loss of sight is alleged to have been caused by injury.

SUMMARY

1. A precise roentgenogram of the optic canal cannot be obtained without a knowledge of the direction of the axis of that canal.

2. The determination of this direction and the placement of the head in this, as in all cranial roentgenography, should be actually measured, never estimated.

3. The calculation of the actual from the roentgenographic dimensions of the optic canal requires a knowledge of the size of the focal spot of the tube used, the distances of the focal spot and of the optic canal from the plate.

4. At least two diameters should be measured and calculated.

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A METHOD OF COMBINING THE HOLFELDER ROENTGEN-RAY FIELD SELECTORS WITH THE SCHMITZ RADIUM ISODOSE RINGS IN THE TREATMENT OF CARCINOMA OF THE UTERUS*

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THE physicists have taught us how to measure accurately the relative depth value of a beam of rays when applied to the surface. The surface intensity is limited practically to an erythema dose. About 35 per cent of this intensity can be delivered to a depth of 10 cm. The average pelvis is about 20 cm. in thickness in the anteroposterior direction. The uterus is located at about the center, or is about 10 cm. in depth. In carcinoma of the uterus, it is necessary to deliver at least 100 per cent of the erythema dose in the most sensitive type, and in some cases probably as much as 500 per cent in the least sensitive would be required to destroy all of the cancer tissue. This latter figure is not practical because of the damage done to the surrounding organs.

In practice with the use of roentgen rays, it becomes necessary to use a number of beams so directed that they will cross and produce a homogeneous distribution of the radiation in the pelvic cavity throughout the diseased tissue. It is not possible to deliver 120 per cent of an erythema dose with one anterior and one posterior portal of entry. The depth dose can be increased by increasing the number of portals of entry, but the more this is done, the greater is the danger of delivering an excess of radiation at some point beneath the surface and causing necrosis of normal tissue, with the formation of abscesses or

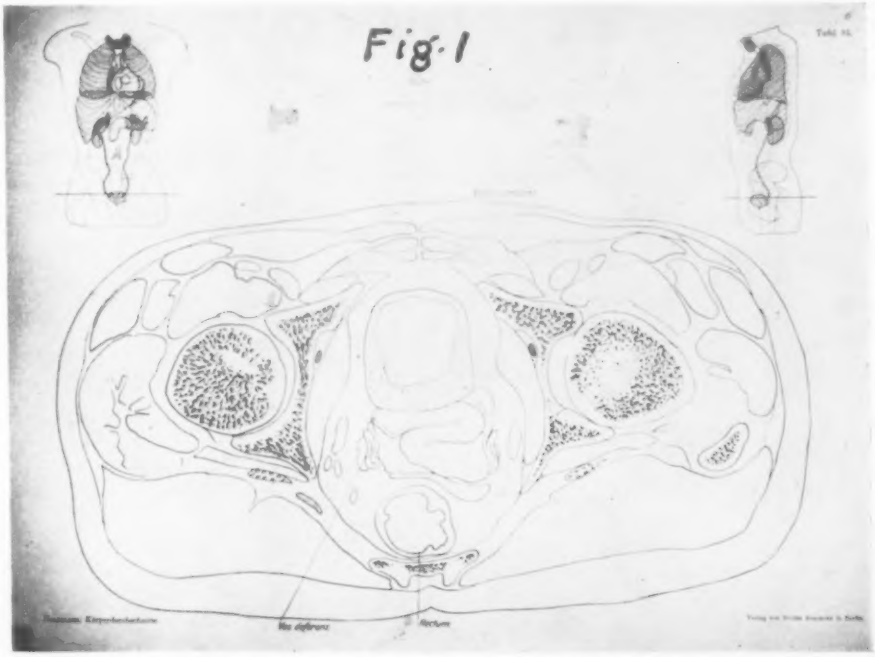

FIG. 1. Transverse section of the body in the region of the uterus photographed from the celluloid film prepared by Holfelder.

* Read at the Sixth Annual Meeting, Eastern Section, AMERICAN ROENTGEN RAY SOCIETY, Atlantic City, N. J., Jan. 22–24, 1925.

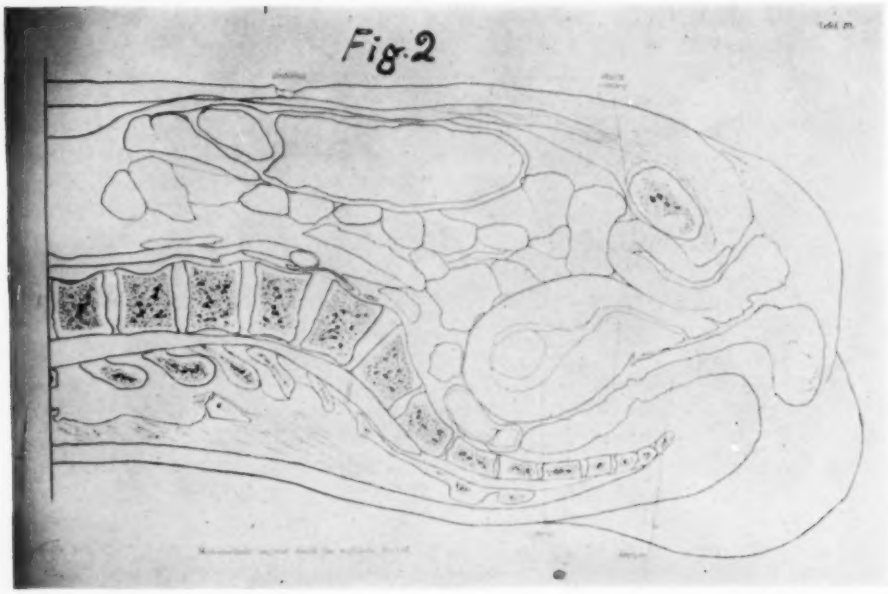

FIG. 2. Longitudinal section of the body with reference to the uterus photographed from the celluloid film prepared by Holfelder.

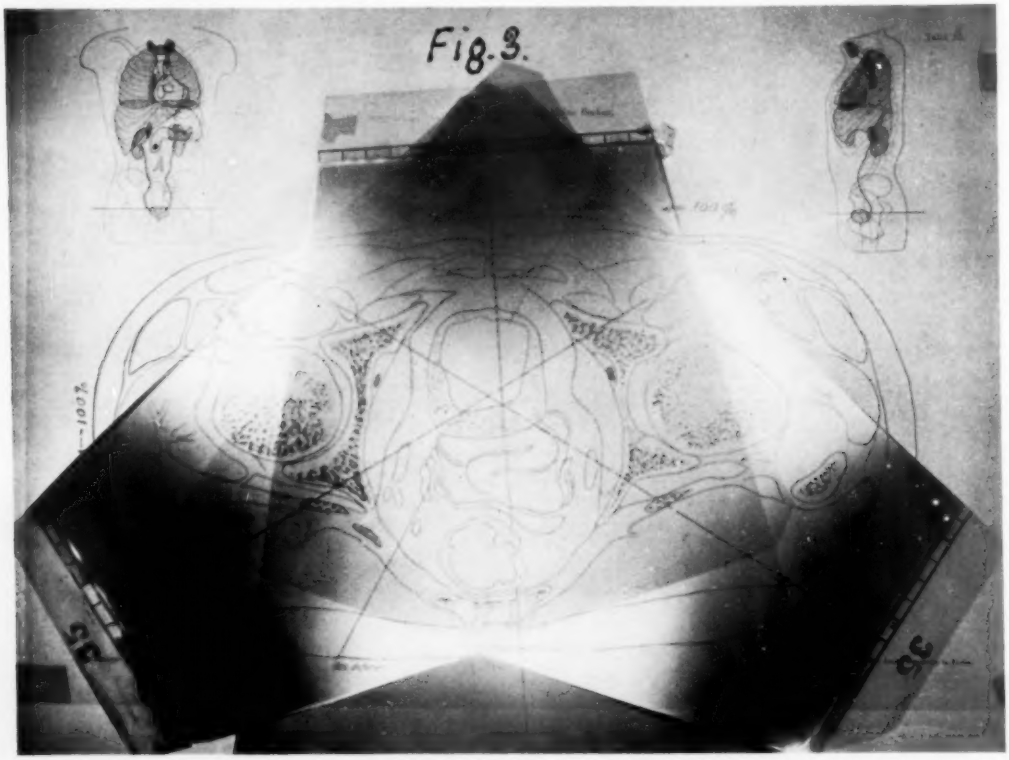

FIG. 3. Shows the field selectors prepared by Holfelder arranged in three fields, across the section of the body (Fig. 1), as suggested by Holfelder. This gives from 90 to 100 per cent of radiation in the general pelvic cavity. The photographed reproduction as shown is not correct because of the difficulty in getting the proper transmitted photographic effect. To the eye this radiation value, as shown over an illumination box, is correct. Therefore this figure must be considered only diagrammatic.

late toxemia. Such an effect may even lead to death.

Holfelder especially has called attention to this danger in various articles, but particularly in his chapter, "Errors and Dangers in Roentgentherapy and Their Avoidance," published in Röntgendiagnostik und Strahlentherapie, by Prof. Grashey (George Thieme, Leipzig, 1924).

As Holfelder has clearly shown, there is great danger of crossing these beams at some point beneath the surface where an excessive dose will be obtained. In arranging the beams one must not only consider the entrance of the rays but their exit, for the rays may give a dangerous crossing near their exit. He therefore urges as general rules that the angle of any two beams should approach at an obtuse angle when possible, and should be made, if possible, to find their exit at an area not involved in an entrance beam. When these dangers are taken into consideration, it is often found impossible to deliver safely roentgen radiation into the pelvis to reach all the malignant disease sufficiently to destroy it.

For the purpose of accurately directing the various beams of rays so as to get the greatest effect upon the diseased tissues and to avoid dangerous cross firing Holfelder has prepared, from actual cross sections of the human body, diagrams representing various sections of the body, both transverse and longitudinal. He has also prepared triangular sheets of celluloid, from which the apex of the triangle has been removed so as to represent the beam of rays beginning at the skin. These are stained so as to represent 100 per cent at the surface of the skin and shaded so as to represent the various relative depth values. These differ according to the size of the portals of entry and as to the relative depth doses in common use with our high voltage, heavily filtered roentgen rays.

In practical use of this outfit, one chooses the celluloid diagram representing the

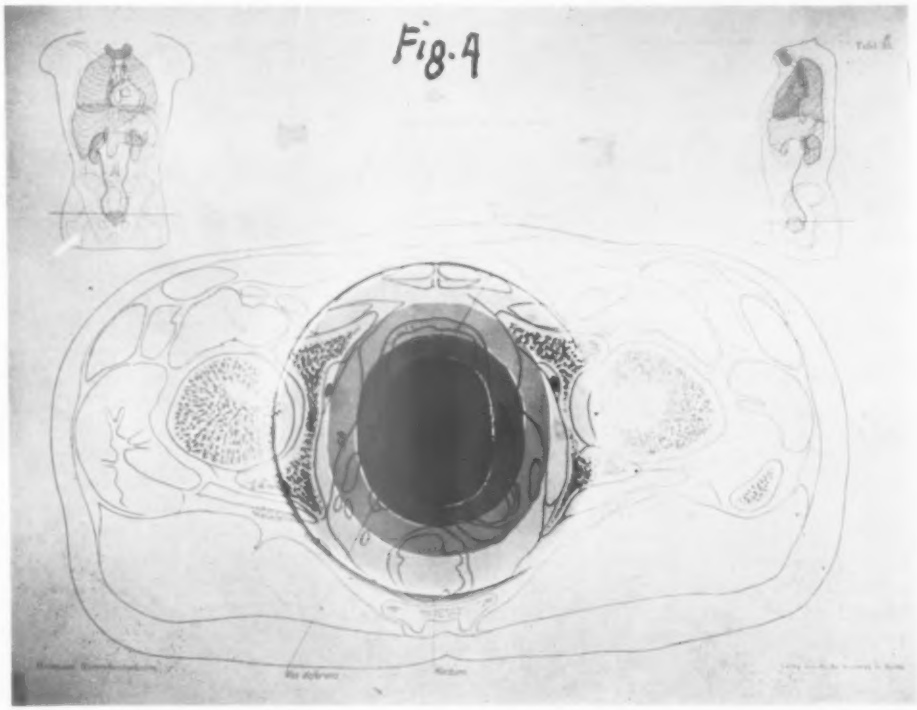

Fig. 4. Shows the Schmitz isodose rings on stained celluloid prepared by us on the same principle and of the same relative value as the Holfelder field selector, arranged to illustrate the radiation effects of radium placed in the uterus when demonstrated over the illumination box. It illustrates the insufficiency of the radium radiation for carcinoma in the parametrium, with the capsule in the uterus.

section of the body to be treated, and places this over a special illumination box. Then one chooses the tinted sheets, each representing the size of portal of entry and the depth value likely to be used. These are then arranged on the diagrams so that one can obtain a shading over the tumor area which is equal to 120 per cent or 20 per cent greater than the surface dose. Frequently it is impossible or impractical to deliver sufficient radiation into the uterus and pelvic area because of the size of the body, without causing serious damage to normal tissue. Fortunately when the uterus is present we have an organ composed of muscular tissue, into which radium can easily be introduced, thereby assisting the radiation from the surface or in early cases of carcinoma even replacing the surface radiation. Generally it is advisable to combine radium and high voltage roentgen rays in the treatment of carcinoma of the uterus.

Schmitz[1] has determined the isodose circles representing the relative value of the radiation at various distances from the uterine canal produced by radium placed in the canal, filtered through 0.5 mm. silver and 1 mm. brass and covered with 1 mm. rubber. We have prepared disks of celluloid corresponding to the radium isodose circles of Schmitz. These have been stained to correspond in relative value to those prepared by Holfelder for his field selection. Their values are 150 per cent in the central isodose circle, 100 per cent in the second circle, with 50 per cent in the third, and 25 per cent in the fourth. This represents the value of 100 mg. of radium in 1 mm. of platinum covered with 1 mm. of rubber and left in place for twenty-four hours.

The first isodose circle is entirely within the confines of the uterus, and while it is

FIG. 5. Shows the combination of these two methods of treatment which can be properly balanced so as to produce any desired amount of radiation in the pelvis, allowing, of course, for the fact that the uterus will stand more radiation than any other tissue in the body.

[1] SCHMITZ, HENRY. A study of the action of measured radiation doses on carcinoma of the uterine cervix. AM. J. ROENTGENOL. & RAD. THERAP., 1923, x, 781–792.

more than an erythema dose, the uterus will stand more radiation than any other organ in the body. Relative to the skin it will stand 200 to 250 per cent. The uterus being centrally located in the pelvis, it therefore forms an excellent screen for radiation, and for this reason when the uterus is removed radium applications are more difficult. It will be seen that the radiation from radium is insufficient when the carcinoma has gone beyond the uterus. It can be clearly understood, therefore, that the two forms of radiation must be used. By arranging these colored disks and the Holfelder colored pyramids over the diagrams of sections of the body, on the special illumination box, one can determine the best arrangement of the surface radiation and the radium applications in the uterus, and thereby avoid underdosing or overdosing. This combination of radiation must of course be varied according to the case. In an early or borderline case, it is our custom to apply the radium at the beginning, and, at the end of a week, begin the application of roentgen rays distributed through three fields as recommended by Holfelder. To avoid radiation sickness this is given in six applications. If no radiation sickness develops, we give this in daily applications, otherwise on alternate days. By this method the radiation is more or less continuous for a period of two to three weeks, and carries out the general idea of Regaud. It enables one to deliver into the uterus in this time 250 to 270 per cent and into the surrounding pelvic tissue 150 to 200 per cent. This seems to combine the best in all theories of radiation treatment of carcinoma of the uterus.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

NORMAL BONES AND JOINTS ROENTGENOLOGICALLY CONSIDERED. (Annals of Roentgenology, Volume Four, Edited by James T. Case, M.D.) By Isidore Cohn, M.D., F.A.C.S., with a foreword by Rudolph Matas, M.D. New York: Paul B. Hoeber, Inc., 1924.

We have purposely refrained from reviewing this volume until we could assure ourselves that it fulfills what we conceive to be the main purpose of such a book, that is, to serve as a daily check and guide in the interpretation of roentgenograms of the joints. After months of constant use during which we have referred to it many times for information about the structure of the joints and their neighboring epiphyses, we have no hesitancy in stating that it fulfills its purpose most satisfactorily.

The need for such a book is well stated in the following quotation from the author's introduction.

"Modern textbooks on anatomy and surgery pay scant attention to this subject. Given a patient with an injury to one of the joints, difficulties are certain to arise in an effort at interpretation. *It is not possible for the roentgenologists to say in a given case that the patient has not a fracture within the cartilaginous epiphyses, provided there is no disturbance of the normal relationship which should exist between the epiphyses and the diaphysis.* This statement is based on the fact that cartilage does not leave a definite shadow in the picture, and therefore, a line of fracture within this cartilage would not be manifest. This is very important from a surgical standpoint; and it is our conviction that when the clinical manifestations of fracture are evident in the young, the roentgenogram should not deter us from the treatment of such a case as a fracture. Furthermore, if the above statement is true, it becomes necessary for us to have a definite notion of the normal relationship which should exist between the epiphyses and diaphysis at given ages.

"Without such a standard for comparison, the roentgenologist is apt to consider many normal joints as 'separations' or even as fractures. Some are willing to believe that it is unnecessary to present a series of normal joints at varying ages for the purpose of comparison, as one can take pictures of the corresponding joint on the opposite side at the same time. Such a procedure is undesirable; (1) because it is an admission of ingorance; (2) because it will be a source of unnecessary expense to the patient and lastly (3) it will not be carried out, for it has not been in the past. Many will continue to do as they have in the past—make a shrewd guess. Often this guess will lead them to the statement that an epiphyseal separation exists, or that it is a possibility.

"Our own experience justifies the statement that many cases which we have treated as so-called epiphyseal separations were in reality normal joints; and many of them were fractures."

The scope of the work may be judged from the fact that the shoulder, elbow, wrist, hip, knee and ankle are each dealt with under the following headings:

"I. A review of the literature. In each instance this review will prove the justification for the present volume.

"II. Conclusions based on the study of the normal joints in question.

"III. Descriptive findings of individual roentgenograms of particular joints at various ages.

"IV. The importance to ba attached to such a study from the surgical standpoint and suggestions of its value to others."

The thoroughness of the roentgenographic illustration of the work may be estimated from the fact that the shoulder is shown at the following ages: seven weeks, five months, thirteen months, two years, three years, four years and six months, seven years, eight years, eight years and ten months, nine years and ten months, eleven years and six months, fourteen years, fourteen years and six months, fourteen years and eight months, fifteen years and four months, sixteen years and ten months, seventeen years and six months, eighteen years and seven months, and at twenty years. The studies of the other joints are equally well illustrated.

The publisher has contributed to the work good paper, excellent reproduction of the roentgenograms and large readable type.

We think it is not too much to state that the book is a valuable addition to roentgenologic literature and indispensable to any busy roentgenologist.

A. C. C.

SURGICAL PATHOLOGY. By William Boyd, M.D., M.R.C.P.Ed., F.R.S.C., Professor of Pathology, University of Manitoba; Pathologist to the Winnipeg General Hospital, Winnipeg, Canada. Cloth. Price, $10.00. Pp. 837, with 349 illustrations and 13 colored plates. Philadelphia: W. B. Saunders Co., 1925.

The title of this book is entirely inadequate; it gives little idea of the scope of the work. The book is, in fact, not only a treatise on pathology for the surgeon but will be found equally valuable by the general practitioner, the internist and the specialist. Its great value lies not in its accurate and concise descriptions of pathological conditions but in the fact that it shows the relation of these conditions to the complicated problems of diagnosis and treatment. The author has aimed to write a practical working guide based on a sound and extensive knowledge of pathology and he has succeeded to a very high degree in accomplishing this object.

The practical aspect of the book is well shown by the second chapter "Surgical Bacteriology." In it is found a discussion of the action of fuchsin and similar dyes upon bacteria; a list of the principal bacteria which cause surgical lesions; a discussion of the organisms causing infections of the skin, abdomen, chest, urethra, meninges, eye, ear, and throat; an account of the various vaccines and their uses, of the non-specific protein substances and of the various sera; directions for collection of material for examination such as pus, blood for cultures, etc., cerebrospinal fluid, autopsy material and urine; a discussion of leucocytosis and its significance in various conditions; and the method of choosing a suitable donor for blood transfusion.

There are chapters on the general subjects of inflammation; wound healing; tuberculosis; syphilis; special wound infections; hemorrhage, thrombosis and embolism; surgical shock; tumors and cysts; and many chapters dealing with diseases of special parts and organs including the neck; thyroid gland; lips, mouth and tongue; stomach and duodenum; intestines; appendix; gall-bladder and liver; pancreas; urinary tract; male and female reproductive systems; the breast; the spleen; the lymphatic system; the pituitary gland; the bones; the joints; the middle ear; etc., etc.

The book is well illustrated throughout with photographs, microphotographs and roentgenograms. A. C. C.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

BUXTON, ST. J. DUDLEY, AND KNOX, ROBERT. A radiographic survey of the normal joints. II. Elbow joint. *Brit. J. Radiol.*, 1924, xxix, 395–410.

The stereoscopic method should always be employed in a study of the normal and in most cases of injury because the parts are seen in true perspective; and it enables the observer to determine immediately facts with respect to diagnosis. In roentgenographing the elbow joint the essential is that the central ray shall pass through the center of the joint. If the arm is placed in one of the usual positions, it should be possible to arrange that the central ray passes through the interarticular space between the lower end of the humerus and the upper end of the ulna. The anterior edge of the coronoid process is readily found, and just above this point would be the line of passage of the central ray.

In the anteroposterior and the postero-anterior positions the forearm is extended to its fullest and placed with the bones lying flat upon the surface, the radial side being placed outwards. This position should give the bones of the elbow joint in their true relations and is the position of choice in the examination of the joint.

Two other positions which may give useful roentgenographic evidence are the internal lateral and external lateral.

A detailed description is given of the roentgenographic aspects of the elbow joint. When the forearm is extended the ulna makes an angle of about 170°. Fractures of the lower end of the humerus are more likely to cause an alteration of the carrying angle than are pathological conditions of the bone. In females the bones of the arm are smaller and less dense and the carrying angle is greater than in the male. It is very important to be acquainted with the exact outline of the head and neck of the radius shown in the roentgenogram. Lateral views in full supination are usually distorted and cause confusion in interpreting this view of the elbow joint. Alteration in the relative positions of the bones is seen in dislocations, the most common one being posterior dislocation of both forearm bones. In such a case the coronoid process may be fractured. Fracture of the olecranon is a fracture into the joint which is revealed in the lateral roentgenogram. Fractures of the head of the radius are intra-articular.

Since the commencement of ossification in each epiphysis of the bones of the elbow joint occurs at a different age, it is possible to state the approximate age of the child from a study of such roentgenograms. When fractures of the lower end of the humerus unite in malposition a great deal of callus is usually formed so that the relationship of the lower humeral epiphyses of the shaft is somewhat distorted. It is interesting that subsequently the normal relationship is reconstituted as the child grows, so that in adult life the lower end of the humerus may appear almost normal though set somewhat at a backward angle with the shaft. A series of 29 illustrations completes the detailed descriptions of the elbow joint.

CASE, JAMES T. The value of the röntgen examination in the early diagnosis of post-operative ileus. *Ann. Surg., Phila.*, May, 1924, lxxix, 715–725.

The roentgen-ray method for establishing diagnosis of ileus is easy to carry out with minimum disturbance to the patient and is suggested as an additional means of diagnosis. Counting the day of operation as the first day, if a patient on the third day after operation presents symptoms suggestive of acute intestinal obstruction, the abdomen is roentgenographed on a 14×17 inch film, the interiliac line being slightly below the middle of the film. The roentgen tube is centered over the middle of the abdomen and the patient is asked to hold the breath while an exposure of two to four seconds is made.

The developed film will reveal at once any gas distention of the bowel or stomach and the approximate localization. Absence of gastric gas accumulation at once rules out postoperative dilatation of the stomach. Small and large bowel may be distinguished by the characteristic outlines of the gas areas. The gas-distended coils in acute obstruction of the jejunum and the ileum are characteristic in appearance. The coils are more or less parallel and the caliber of the gut is increased to $1\frac{1}{2}$, 2 or even 3 inches as measured on the film. The distention is not confined to the short segments of the intestine but involves usually several loops. The serrated contour of the small intestine is characteristically different from that of the colon due to the markings of the haustra coli.

Observation of the cecal region is usually helpful, for if the cecum contains gas it is not likely that the obstruction is in the small intestine. If the gas collections are seen to occupy the middle of the abdominal shadow while the flanks are gas free, it is probable that the obstruction is in the lower ileum, though not so low as the ileocecal valve. When the gas areas occupy the true pelvis and the middle of the abdominal shadow one may suspect the ileocecal region. Intussusception may be recognized by colonic injection with opaque enema.

If the observation of the gas filled bowel (without the ingestion of barium) does not reveal the approximate location of obstruction, barium enema should be given to rule out colonic obstruction. If the entire colon fills it means that the obstruction must exist in the small bowel. If the findings are still indecisive a small amount of barium suspension should be given by mouth.

CALVÉ, JACQUES. An affection of the vertebral column in the child simulating Pott's disease. *J. de radiol. et d'électrol., Par.*, January, 1925, ix, 22–27.

Two cases of conditions similar to Pott's disease are reported as occurring in two children, aged two and one-half and seven years respectively. The first, a boy, had pain in the back, stiffness of the vertebral column and the appearance of a small deformity in the dorsal region; a diagnosis of Pott's disease was made the patient treated accordingly. Treatment by hyperextension was followed by reduction of the gibbosity and by apparent cure. The other case (a patient of Dr. Brackett of Boston, reported here by permission), aged seven, suffered pain in the back and abdomen; examination showed generalized contraction of the vertebral muscles. There appeared a condition of gibbosity, which led to a diagnosis of Pott's disease; however, there were no abscesses nor indications of medullary compression. After a year of treatment, the gibbosity disappeared and the child was able to lead an active life, with certain precautions and by the wearing of a suitable corset. There were no complications, and the treatments, being instituted at the proper time, were effective in bringing about apparent cure.

Roentgenograms were made in both cases. It was found that only one of the vertebrae in each case was affected. There was destruction of the transverse process, such as is often found in tuberculosis of the vertebrae. There was increased neoformation of cartilage in place of the bony structure destroyed; as the bone decreased, the cartilage increased, and there was more cartilage than bone in the case of the boy seven years old. The opacity of the bony structure of the affected vertebra was increased over that of the other vertebrae. Indications were apparent of regeneration of bony structure. This regeneration of the bone removed definitely the possibility of tuberculosis of the vertebra. Also, the reaction to tuberculin was negative in both cases; the Wassermann reaction was also negative in both. The parents of the patients were quite sure that no severe traumatism had been suffered by either of the children. The condition was not congenital, but acquired; the indications were that they were of infectious origin, for in one of the cases, fever accompanied the onset of pain in the back. Because of the above characters observed, the condition noted appears to have a relation to the affections known as osteochondritis deformans juvenilis and infantile scaphoiditis, diseases known as Calvé-Legg and Köhler respectively. The greater amount of cartilage than bone, the increased opacity of the remaining bone in the process, the probable infectious origin, age of the patients, and the character of the symptoms place the condition very close to Calvé-Legg and Köhler's diseases, with indications similar to Pott's disease.

FAVREAU, LABEAU AND BOSC. Necessity of the popularization of the roentgenography of the fetus during gestation. *Presse méd., Par.*, Oct. 1, 1924, No. 79, 786–788.

The writers first give a review of the literature in which diverse claims are made as to the value of the roentgenogram in studying the fetus during pregnancy. Most workers in this field have shown good results in the use of this means of following the growth, size and position of the fetus. Some observers claim to be able to distinguish the fetal skeleton by the beginning of the third month, while many others have obtained definite pictures of the fetus by the third month. Others, however, have not been so successful until after the fifth month of pregnancy. The writers were successful in distinguishing the fetal skeleton in 5 out of 11 cases in the fourth month; after four and a half months, in all cases positive results were obtained. This corresponds with the time when heart is definitely beating. It seems, then, that about the fourth month a study of the fetus may be made by this means. Roentgenographic observations are of particular importance in connection with possible fibroma during pregnancy, and the ability to distinguish such tumor when present. Also, the method may be used in cases of doubtful pregnancy, when clinical evidence is doubtful.

A case is cited when this was found to be quite useful in determining not only pregnancy, but the approximate period of gestation, etc. Determination of the age of the fetus is quite easily accomplished by this means. The number present *in utero* may be determined at about the fourth month, and later the position of the fetus, as well as any malformations may be determined. The use of this agency is urged as an important agency for greater accuracy, and as giving added information in cases of pregnancy and should deserve a wider application than has been the case in the past.

GASTAUD, P., AND MARCHAND, J.-H. Hypertrophic tabetic arthropathy. *J. de radiol. et d'électrol., Par.*, January, 1925, ix, 28–30.

Tabetic arthropathy of the vertebral column is not uncommon, but it is unusual to find also hypertrophy such as was observed in the case reported here. The patient had been suffering from locomotor ataxia since 1919, with difficulty in walking. Treatments resorted to at this time were without effect; in 1922, however, the patient was able to walk without a cane. In 1923, the pain, especially in the left leg, increased, and later the aid of two persons was required at times in order to walk. In spite of this, the patient was ordered to exercise, massage the limb and to walk as much as possible. The pain increased, and the patient then went to Professor Sicard in France, who diagnosed the condition as paraplegia with steppage gait, abolition of reflexes and muscular atrophy; the tabes was of long duration, about twenty-five years with radicular neuritis and tabetic arthropathy of the vertebral column. Roentgenograms of the vertebral column showed arthropathy extending throughout the lumbar vertebrae; the first lumbar vertebra was joined to the second. The second and fifth vertebrae were joined together by proliferation of the covering around the vertebrae. The contour is that of a sleeve over the adjoining vertebrae by which they are joined together more compactly. The roentgenogram indicates either a spontaneous fracture or ossification of syphilitic lesion.

HOED, D. DEN. A separate centre of ossification for the tip of the internal malleolus. *Brit. J. Radiol.*, February, 1925, xxx, 67–68.

Roentgenographic examination of 150 healthy children aged six to twelve, showed 21 cases in which there were separate centers of ossification for the tip of the internal malleolus. The size varied from that of a pinhead to a lentil. It is probably not so rare as has been believed, and it may be that under ordinary conditions this may have been interpreted as a sesamoid bone or perhaps a fracture. Fourteen of the cases were boys and 7 girls. Examination was confined to but one side so that there is no information as to whether this condition is bilateral.

HURST, ARTHUR F., AND BRIGGS, P. J. Diverticula of the stomach: A possible source of error in the radiological diagnosis of gastric ulcer. *Brit. J. Radiol.*, January, 1925, xxx, 1–8.

Diagnosis of a diverticulum of the stomach is easy because of its remarkable position, even outline, uniform rounded shape, free mobility both with the stomach and to a slight extent independently of it, and the absence of tenderness, provided the existence of this condition is recognized. In the absence of such recognition a diagnosis of ulcer would appear to be inevitable in spite of the very unusual roentgen picture.

A series of 4 cases occurring in women is described in which the diagnosis was made during life. A diverticulum about the size of a cherry was found in the immediate neighborhood of the cardia. It moved freely on deep respiration and was situated much too high to be connected with the pancreas. In the erect position the upper surface of the opaque contents in the diverticulum was horizontal with a gas bubble above it. The opaque contents of the diverticula are usually retained for a long time after the meal, although the rest of the stomach emptied promptly.

LECÈNE, PAUL, AND MOUCHET, ALBERT. Contribution to the pathology of tarsal scaphoiditis in young children. *J. de radiol. et d'électrol., Par.*, August, 1924, viii, 357–360.

A report is given of a case of tarsal scaphoiditis, the diagnosis of which was doubtful due to the intense physical symptoms and the insignificant roentgenologic observations. There was a painful swelling in the left foot in the region of the scaphoid which caused difficulty in walking. There were no indications of tuberculosis nor syphilis. Roentgenograms of the left and the right foot showed a distinct alteration of the scaphoid of the left foot; the other bones of the foot were normal. The scaphoid was flattened (8 mm. in diameter instead of 11 mm.) and spread laterally to 22 mm. instead of 18 mm. and it was deformed in contour. Removal of the scaphoid confirmed the observations made in the roentgenogram as to contour, and a diagnosis of inflammation of the tarsal scaphoid was made. The central bony structure showed distinct lesions; a part of the spongy tissue was fissured, but the

articular cartilage on the anterior and posterior sides did not present any lesions. Microscopic examination showed the cartilage to be normal; the spongy tissue in the medullary spaces was partly filled with fibrous and vascular tissue. The necrotic tissue contained very numerous polymorphonuclear and mononuclear cells in the cellular debris. It was not possible to observe the presence of any microorganisms; methylene blue, Ziehl's and gentian violet stains were used for this purpose. It was impossible to determine the cause of this inflammation. It is quite apparent, from microscopic study of the sections, that this is a process of osteomyelitis in which the formation of necrotic foci is characteristic. The excessive calcification of the scaphoid is the only change noticeable by means of the roentgenogram. It resembles a fracture by compression, and heretofore may have been mistaken for this.

This is the first case on record in which inflammation of the tarsal scaphoid has been studied microscopically in the removed bone.

LEE, WALTER E. Post-operative pulmonary complications. *Ann. Surg., Phila.*, April, 1924, lxxix, 506–523.

The various factors such as anesthesia, infection (pre- or post-operative), preexisting lung disease, old age and debility, and chilling of the body are merely contributory factors to postoperative pulmonary complications; the primary factors are pulmonary collapse of varying degree, together with pulmonary embolism and infarction.

The roentgen ray is of prime importance in fixing the true nature of the complication. In the case of pulmonary embolus and infarction, the roentgenogram will show the infarcted area triangular in shape with the base toward the periphery and the apex toward the hilus of the lung. In spontaneous pneumothorax, the shadow density on the affected side is very much diminished and the diaphragm is markedly depressed because of increased intrathoracic pressure.

Postoperative massive collapse of the lung is a rather common occurrence and probably is due to more than one factor. There may be bronchial obstruction due to mucous plugs or foreign bodies, or possibly some paralysis or bronchial spasm due to reflex irritation from other parts of the body. It may also be due to arrest of the respiratory muscles either of the chest walls or of the diaphragm, such arrest being caused by direct nervous influence, but usually by posture. The roentgenogram of such a thorax shows a density of the collapsed lung, a shift of the heart shadow to the affected side and elevation of the diaphragm on the affected side, all due to the decreased intrathoracic pressure.

MAKINS, GEORGE. Discussion on myositis ossificans traumatica. *Brit. J. Radiol.*, September, 1924, xxix, 323–334.

The name of this condition is inappropriate since the process is not inflammatory but rather one of misdirected regeneration or repair, while the muscle itself plays a purely passive part. The essential requirement for causation is a lesion of the muscle due either to a blow, a strain or over-action which may not be severe in degree. Almost any muscle attached to bone may be affected.

This condition is to be sharply differentiated from ossifications known as "rider's bone," "fencer's bone, "dancer's bone." In these the development of bone starts at the point of origin of the muscle and is excited by over-use or irritation of the muscle concerned. This is a gradual process in no sense comparable or identical with a rapidly developing ossification in the quadriceps or brachialis anticus following an injury to these muscles and the bone to which they are attached, and the bony outgrowths show little tendency to reabsorption. The condition should also be kept distinct from metaplastic ossification occurring notably in tabes.

Traumatic myositis ossificans should be limited to the condition consequent upon an injury in which the following three factors are associated: (1) an injury to the periosteum or bone of sufficient severity to allow of the escape of bone cells into the neighboring muscle sheath; (2) hemorrhage from the bone; (3) an injury to the muscle sufficient to open its sheath. The shape and structure of the tumor due to its location within the muscle. The diagnosis of this condition is fairly easy. There is a uniform history of primary injury and the regular course taken by subsequent events are in themselves suggestive. The characteristic structure presented by the roentgenogram is sufficient to rule out any suspicion of sarcoma in either of its varieties.

The primary treatment in all cases should be complete rest and avoidance of anything likely to increase the vascularity of the affected part since the general tendency of the tumors is to undergo spontaneous absorption and to leave no serious trace behind them. The bony masses may become absorbed less rapidly, but difficulty chiefly arises in instances where the ossification in the muscle is associated with ossification in the fibrous tissue structures around a joint as in the elbow, when operative treatment may become necessary at a later stage.

MORRELL, REGINALD A. A case of congenital, right-sided diaphragmatic hernia. *Brit. J. Radiol.*, May, 1924, xxix, 171–174.

The condition was discovered in a woman, aged fifty-seven, who complained of a sensation of discomfort and dragging under the left costal margin. The hernia was located on the right side and the chief cause of the patient's discomfort was apparently a dilated stomach.

Roentgenoscopic examination following a barium meal showed a mass in the right thorax which did not move on respiration and in which the lobe of the diaphragm was absent. The heart appeared in normal position but there was a well-marked lateral deviation of the spinal column. The stomach was found to be very much dilated and situated on the left side.

A more recent examination of the hernial mass in the thorax, when seen in profile allowed differentiation into the following parts: (1) the terminal portion of the ileum; (2) the cecum; (3) the ascending colon, and (4) about the first quarter of the transverse colon. The latter descends through the diaphragm into the right hypochondriac region.

NICAUD, P., AND DOLLFUS, M. A. Contribution to the study of the diagnosis of bronchial dilatation by roentgenologic examination after use of lipiodol. *Presse méd., Par.*, Oct. 15, 1924, No. 83, 817–818.

Two case reports are given in which the use of lipiodol before roentgenograms were taken made possible the diagnosis of bronchial dilatation which had been clinically diagnosed as tuberculosis for many years. The first patient gave symptoms of intense diffuse bilateral bronchitis; hemoptysis was pronounced, but the sputum was negative for the tubercle bacillus. The roentgenographic diagnosis after use of lipoidol was easily and precisely made, dilatation of the bronchial tubes being clearly evident. No positive pulmonary lesions were noted, but the dilatation was more marked on the side which, by percussion, indicated cavity formation. Roentgenogram without previous use of lipiodol did not permit of positive diagnosis, and did not show cavities. In the other case, bronchopneumonia after measles left lesions which were clearly recognized, but the roentgenogram after use of lipoidol showed clearly the dilated bronchial tubes. This patient had been treated for tuberculosis for a number of years, and had been retained in different hospitals for treatment. This diagnosis was maintained in spite of consistent negative sputums. By use of the lipiodol and roentgenogram, definite bronchial dilatation was clearly observed. The lipiodol was injected sub-glottis, after local anesthesia, (after warming to 37°C.), into the trachea, and the roentgenogram taken immediately.

SCARGILL, HAROLD B. Two cases of diverticula of the bladder. *Brit. J. Radiol.*, September, 1924, xxix, 323.

The two diverticula were demonstrated as follows: The bladder was well washed out, emptied by catheter and then filled with 20 per cent solution of sodium bromide. This filled the diverticula as well as the bladder. The roentgenogram was taken with the patient on a Bucky-Potter diaphragm. The bladder was then emptied by catheter and another roentgenogram taken. The sodium bromide solution remained in the diverticula. The first case showed a huge diverticulum of the left and a small one on the right. The second case had a large single diverticulum on the left.

SERGENT, EMILE. New ideas bearing on the roentgenologic study in the diagnosis of pulmonary cavities. *Presse méd., Par.*, June 11, 1924, No. 47, 509–511.

The writer gives a detailed discussion of the value and limitations of the roentgenogram and roentgenographic study of pulmonary cavities. In the first place, he calls attention to the well-known fact that at autopsy many more lesions are found than were suspected from clinical examination during life. Reasons for this are given, such as tuberculous lesions being masked by inflammation, some of them too small to find by the usual clinical methods, etc. By means of the roentgenogram and roentgenoscopic observations, it is possible to find many more cavities than are noted by clinical examination; that is, there are "inaudible" cavities which are readily visible in the roentgenogram. In the latter method, there are also false cavity images, so that one is apt to think more cavities are present than there are. Also, many of the cavities identified by clinical observations are not noted in the roentgenogram. Therefore, it is wise to rely upon both methods of diagnosis rather than consider the roentgenoscopic method as so far superior to the clinical as to supplant it altogether. The writer gives some of his own observations in which so-called "silent" cavities were found by means of the roentgenogram. In a suspected case of tuberculosis, in which there was hemoptysis, abundant sputum which showed large numbers of tubercle bacilli, stethoscopic examination, percussion, palpation, and auscultation did not reveal pulmonary cavities; roentgenoscopic examination showed well-defined cavities to be present. Stethoscopic examination often indicates the presence

of a cavity when there is none, as may also the roentgenologic examination. It is necessary to recognize the existence of true cavities, "silent" cavities, and visible cavities. There should be a revision of the indications of true cavities. Use of both the above methods, although they are not in agreement in many cases, will nevertheless serve to give more exact and precise information and insure a more accurate diagnosis of pulmonary cavities.

STANFORD, R. V., AND GOODALL, EDWIN. Observations upon the passage of a barium sulphate meal in twenty-four cases of mental disorder. *Brit. J. Radiol.*, 1924, xxix, 63–66.

In a previous communication it was reported that in only 3 of 10 cases of dementia precox were the observed bowel movements free from abnormalities. The usual finding was delayed evacuation from the large bowel and spasticity of the colon.

The present observations were made upon 15 males and 9 females suffering from melancholia, dementia, insanity, etc. Nineteen of the cases were recent and acute. The roentgen-ray examinations showed possibly 2 or 3 free from abnormal states of the gastrointestinal tract. The evidence points to stasis and to ptosis of the transverse colon (in some cases of the stomach also) and spastic contraction of the same as being a very common occurrence in such cases. Four illustrative cases are briefly described.

WYARD, D. Some remarks on the value of the opaque meal from the point of view of the physician. *Brit. J. Radiol.*, 1924, xxix, 368–386.

Roentgenography of the stomach is capable of giving positive information of value from the point of view of diagnosis and treatment in the following conditions: (1) congenital anomalies such as diaphragmatic hernia; (2) gastroptosis; (3) gastric ulcer; (4) carcinoma; (5) gastrectasis; (6) hypermotility; (7) aerophagy; and (8) foreign bodies. The position of the stomach may be from 2 to 3 inches above the umbilicus down to a position in the true pelvis. The size also varies greatly and the interpretation of these is rather difficult. The stomach possesses a regular outline and any irregularity apart from peristalsis is conclusive evidence of an organic lesion. The presence or absence of peristalsis is of no significance except in conjunction with other roentgenological, clinical and pathological evidence.

Although in the majority of cases little importance attaches to diaphragmatic hernia, yet it might lead to gastric symptoms owing to obstruction to the passage of food or even to complete occlusion of the alimentary canal, a strangulated hernia.

Gastroptosis is merely an effect, and the cause must be carefully sought out. It should also be remembered that the sudden introduction of a heavy mass of inert metallic salt into an empty stomach may not unreasonably be expected to drag it down to some abnormal level. Consequently, a good deal of caution and skill must be exercised in diagnosis of true gastroptosis. Where the stomach keeps its tone and motility and the angulation between the duodenum and pyloric canal is not so sharp as to produce a functional obstruction, the patient may present no symptoms whatever and remain in perfect health despite the fact that the organ lies well below the umbilicus. It should be remembered that the greater curvature extending down to the pelvic brim does not necessarily mean gastroptosis. Gastrectasis due to pyloric obstruction may be of such degree that the curvature reaches this level, but the lesser curvature is high up in a practically normal position so that the stomach is enormously dilated but not dropped.

The interpretation of the roentgenographic findings in gastric ulcer is often very difficult. In practically every case of gastric ulcer there is some delay in emptying which is not the case with duodenal ulcer where emptying is rapid and complete. Any irregularity in outline is suggestive and as a rule such irregularity is in the line of the lesser curvature since ulcer rarely, if ever involves the greater. The characters of the duodenal cap have no significance as a positive factor in the diagnosis of gastric ulcer. Irregularity in the duodenal cap may indicate the presence of gallstones in the gallbladder and serve to differentiate between gastric ulcer and cholelithiasis with gastric symptoms. Hour-glass contraction of the stomach is easily detected but may escape diagnosis. The deformity may be due to cicatrization of a simple ulcer or the presence of malignancy which cannot always be distinguished apart roentgenologically.

The essential roentgenologic feature of carcinoma of the stomach is a filling defect. It occurs most usually in the pyloric region. Peristalsis is always sluggish and often absent. Gastrectasis may be acute or chronic. The latter may be due to pyloric stenosis which produces the most extreme degree of dilatation, or to atony of the walls without organic obstruction. In the atonic variety peristalsis is minimal or absent and cannot be detected roentgenographically.

Examination of several cases of hyperacidity both reontgenologically and pathologically makes it appear probable that hypermotility is a better designation of the condition than hyperacidity. The gastric peristalsis is abnormally active and the organ passes its contents rapidly so that it is completely empty in two to four hours. It is suggested that roentgen rays present a less objectionable means of making a diagnosis of hyperacidity than by the usual test meal which is objected to by certain "difficult" patients.

ROENTGEN AND RADIUM THERAPY

BARJON, F. Reflections on the treatment of tuberous vascular nevi with the roentgen ray. *J. de radiol. et d'électrol., Par.*, January, 1925, ix, 15–21.

In the treatment of nevi, it is necessary that the type of nevus be clearly understood; the nevi plani, are not subject to treatment with the roentgen ray, whereas, the tuberous type of vascular nevi, if properly treated at the right time, will react very favorably to this treatment. Failure to effect cure of nevi plani heretofore has been due to a lack of understanding as to the limitations of the method in such cases. These two types of lesions are distinctly different: the nevi plani is of intra-uterine origin, it is a fetal lesion, acquired and immutable. Tuberous nevi are not simple spots, but tumors of an evolutionary character and they are rarely of intra-uterine origin; usually they occur soon after birth and growth takes place during the early months of infancy. It grows with great rapidity. This essential difference between the two conditions is sufficient to separate them clearly for purposes of treatment. The nevus planus is not sensitive to the roentgen ray; the tuberous nevi are readily reactive to the rays in the early stages. It is important, too, in using the roentgen ray in treating the tuberous nevi that such applications shall be made during the first six months. Not only is the treatment more effective at this stage, but the growth of the tumor will be checked and a less objectionable scar is left. It is easier, also, to handle the child at this age, and there is less difficulty in applying the treatments. It serves to prevent ulceration, and other complications, such as hemorrhage and secondary infections. In the adult, from eighteen to twenty years, the tumor is well organized and will be much less reactive to treatment; stronger doses are necessary at this stage. The dosage is based on the condition of the tumor; the writer never applied more than 4 H. Twelve H were given in 3 doses of 4 H each, at three to 4 weeks' interval. The rays were unfiltered; a penetration of 5° to 6° Benoist seems best in most cases.

BONER, L. The treatment of whooping cough by roentgenotherapy. *J. de radiol. et d'électrol., Par.*, November, 1924, viii, 509.

Six cases of whooping cough are reported in which cure was brought about by treatment with the roentgen ray. In some of these cases, hypodermic injections with Néo-Dmetys failed to effect cure; the use of the roentgen ray on these same cases resulted in complete and rapid cure. In the first case, the cough was stopped completely after 5 treatments; in the second case, which had been treated for four weeks by injections of Néo-Dmetys without success, the cough stopped after 5 treatments; cure was effected in the third case after one treatment; 3 treatments were sufficient to cure the fourth case; 2 treatments sufficed in the fifth case, and 4 in the sixth. The ages of the subjects ranged from eight months to 7½ years. The treatments were made as follows: a Graiffe (*crédence*), No. 2 transformer, a Chabaud bulb of 18 to 20 cm. spark and 0.08 to 1.0 ma., filtered through 3 to 5 mm.; each treatment required 1 to 2½ H to the skin, applied in the region of the sternum, at intervals of 4 to 5 days. It is thought the roentgen rays act upon the tracheobronchial adenopathy, which often accompanies whooping cough.

COLE, PERCIVAL P. Treatment of inoperable cancer of the uterus. *Brit. J. Radiol.*, July, 1924, xxix, 253–261.

Inoperable cases are considered to be those unsuited for a radical Wertheim operation by any standard of assessment. One method of treatment of such cases is the so-called cold cautery method of Percy. In this technique the object is to raise the temperature of the tumor mass to about 100°F. sufficient to destroy the cancer cells. There are three types of cases that have been dealt with exclusively by radium; namely, those in which exploration has shown them to be unsuited for the cold cautery operation; those which on examination have been regarded as unsuitable owing to the risk of fistula formation; those cases in which recurrence has appeared in the vaginal vault after a radical operation or in which carcinoma has affected the cervix left after a supravaginal hysterectomy. Wherever possible the abdomen is opened as for the cold cautery treatment, and the iliacs and other vessels are tied off. The radium is then inserted, the

site being determined by the guiding directions of the abdominal assistant. The results thus obtained are claimed to be superior.

The dosage has varied but has rarely been less than 100 mg. Where possible a tube of 50 mg. is inserted into the cervical canal and the radium needles, varying in number from 6 to 10, are plunged directly into the surrounding growth, the time of exposure varying from eighteen to twenty-four hours. A rather distressing complication of repeated radium insertions is pain in the lower part of the back and radiating down to the thighs. This pain varies in intensity but is frequently severe and causes the patient to refuse to submit to further irradiation. There seems to be no reliable means of arresting this pain. Patients receiving this radium treatment have survived from two years, to two years, eight months, and their condition during this interval was very much improved.

BARRINGER, BENJ. S. Radium in the treatment of prostatic carcinoma. *Ann. Surg., Phila.*, December, 1924, lxxx, 881–884.

The method of radium treatment by needles makes use of a dosage varying with the size of the tumor, but at any one time rarely more than 800 mc-hr. are given. If there is ureteral invasion, screened radium (silver 0.5 mm.) is used in the catheter, the dose being about 200 mc-hr. (Bare tubes of radium are not used in the prostate as they cause undesirable slough and pain.) This completes the treatment in from two to three months, a slight sclerosis of the carcinoma going on during this period. Every two or three months radium treatments are repeated until in cases which react well the prostate is a sclerosed mass, although such cases are rather rare.

In cases of urinary obstruction in advanced cases, a modified Young punch is used to clear an opening in the bladder neck. Brief reports are given of 5 cases that have survived for more than five years. Bone metastases have been found to have occurred in 27 per cent of the 44 cases observed. It appears that 5 to 10 per cent of the cases of primary carcinomas of the prostate can be controlled by radium.

DOWD, CHARLES N. Report of the results of operation on a group of 150 cases of goitre. *Ann. Surg., Phila.*, September, 1924, lxxx, 391–399.

The end-results in 150 cases operated on for goiter between 1899 and 1924 are discussed. It is believed that the few operative fatalities that occurred early in the series were due to improperly chosen conditions. Cancerous thyroids and a few cases observed late in the disease are not included in this series. As a result of surgical treatment practically 69 per cent of the patients are enjoying good health and able to do an ordinary amount of work. About 21 per cent more of these cases are able to enjoy life and do moderate work, but have to avoid over-exertion. The operations were adjusted to meet the strength of the patient, some of the operations being performed in stages.

An indefinite number of the cases had received roentgen-ray treatment before coming for surgery and some had received postoperative treatment. Four patients received roentgen-ray treatment without operation. Two of them were very mild and have done well. A third case was toxic and when first treated had marked tremor, basal metabolic rate plus 35 and a very small thyroid. He responded well to roentgen treatment. Another case with a large adenoma and very mild toxic symptoms preferred roentgen treatment to operation and after the lapse of a year he is in about the same condition as when first seen.

It is notable that experienced roentgenologists consider hyperplastic thyroids the most suitable for roentgen treatment and that many failures of relief come after roentgen treatment of such goiters. Adenomata, which are not so well suited for roentgen treatment, produce some of the most disturbing symptoms and respond fairly well to surgery. So many failures have been noted in patients treated medicinally and by roentgen rays that operation is believed to be the best form of treatment for a very large proportion of patients with goiter.

GUNSETT, A. The dangerous effects of large doses given in a short time. Are small doses injurious? Do they cause growth of neoplasm? *J. de radiol. et d'électrol., Par.*, November, 1924, viii, 481–508.

Certain German workers have published new methods of roentgenotherapy of cancer which may be summed up as follows: (1) use rays of sufficient penetration with filtration through at least 0.5 mm. of zinc; (2) application of a "cancericide" dose based on the erythema dose; (3) application of this dose in one treatment. (In radium therapy, application of a strong dose given over a period of a very short time.) Lately, however, many German authorities have abandoned these strong doses because they have proved inefficient in many cases. The French also use strong doses, but spread the treatments over a period of a week; short applications of strong doses over a prolonged period is more effective in destroying the neoplastic cells. The irradiation of cancers has two effects, local and general, or direct

and indirect. Experimentally on mice, the general effect of the roentgen ray on the ultimate cure of artificially produced cancer is marked. An increase of the means for natural defense in the organism is the outcome of the general or indirect benefit of irradiation. This opinion has been stated by numerous authors. For this reason, a reduction in the strength of the doses given may well be considered, since destruction of the neoplastic tissue by the direct action of the rays is not the only result to be sought.

The German method of using large doses in a single treatment is considered dangerous by various authors; a definite lesion and traumatism of the organism usually follow such large doses. The larynx seems to suffer most from these large doses; necrosis of the larynx may be followed by death from this cause. Cure of cancer of the larynx is not rare in France where the French technique is used,—reduced dosage spread over several days. On the other hand, one German worker reported death of the patient from arterial hemorrhage after treatment of cancer of the larynx by the German method. The dangers from the use of large doses given in one treatment are local and general; the effect on the tissue surrounding the tumor and on the organism in general is decidedly dangerous. Some of the causes of the ill effects of large doses have been explained by various authors as follows: intoxication in the blood due to products of decomposition from the tumor, the action of the roentgen rays in destroying leucocytes, hemoclastic shock, influence on the nervous system, biochemical alteration of the cells, an alteration of the endocrine system, alteration in the functioning of the liver, etc. Fatigue, loss of appetite, malaise, vomiting, diarrhea and other results of large doses are given the general term "mal des rayons" and are the direct result of the strong doses given. Examination of the blood after such doses shows leucopenia, lymphopenia and diminution of eosinophiles. The time factor is very important in these alterations.

Although the proper doses of roentgen rays cause degeneration and death of cells, some authorities have stated that the irradiation with a weak dose causes a stimulating action on nuclear division and new growth of cells. This has been tried on both plants and animals. It has been said that small doses stimulate, medium doses paralyze, and large doses destroy. Weak doses also are used in certain pathological conditions for curative purposes because of this stimulation of normal activity in the cells concerned. The writer made extensive investigation of this point and could not confirm the stimulating effect of weak doses on either plant or animal tissues; the results were quite irregular, but he was never able to produce growth more rapidly nor in greater abundance than in the controls, except as might occur naturally. The author could not show any stimulating effect of weak doses on experimental cancer, nor in natural cancer in humans. In other words, weak doses will not stimulate growth of normal nor neoplastic cells.

JACKSON, ARNOLD S. Conclusions based on a study of four thousand cases of goitre. *Ann. Surg., Phila.*, June, 1924, lxxix, 840–844.

Much confusion exists over the diagnosis and treatment of the various forms of goiter. A simple classification of the various types is desirable, as for instance the following: (1) colloid goiter, (2) adenoma, (a) with hyperthyroidism (toxic adenoma), (b) without hyperthyroidism (simple adenoma), (3) exophthalmic goiter (Basedow's or Graves' disease), (4) tuberculosis, malignancy, syphilis, thyroiditis, actinomycosis, etc. The various clinical types of cystic, calcareous or hemorrhagic goiter are merely degenerative forms of adenoma.

Among the preoperative measures should be included an examination of the vocal cords in every case of adenoma of the thyroid, since there is partial or complete paralysis of one or both cords in one out of every 15 cases. This evidence may prove important from a medico-legal standpoint postoperatively. Roentgen-ray examination of the chest is of value in eliminating substernal or intrathoracic goiters.

In toxic goiter, 85 per cent of the cases are cured by surgery. Medical measures may temporarily benefit but they delay the relief possible to obtain by surgery. Roentgen ray and radium are contraindicated in the treatment of any type of goiter except exophthalmic goiter. In these cases treatment must be continued over a long period of time and the results are uncertain.

The above conclusions are based on surgical and non-surgical cases observed during the past five years in the Jackson and Mayo Clinics.

JENTZER, ALBERT. Treatment of cancer of the esophagus with an automatic radium holder. *J. de radiol. et d'électrol., Par.*, December, 1924, viii, 529–542.

Case reports are given in which radium was used in treating cancer of the esophagus. The following technique was used: irradiations were made for 80 hours under the following conditions: tube measuring 3 to 4 cm. in length, containing 34 mg. radium bromide 100 per

cent, and filtered through 1¼ mm. silver. Irradiation = 18 mc. × 72 h. = 1296 mch. In the notation of Regaud: 18 mc. × 0.0075 × 72 h. = 9.72 mcd. (mcd. = millicuries destroyed). The author's technique differs from that of Guisez in that systematic irradiation is practiced for 24 hours on the lower, middle and upper part of the cancer for three days (72 hours in all), and in that strong doses are used. After applications of radium, the author always followed with progressive dilatations, twice a week, which often gave exceptional results.

The following case reports are given: (a) patient, aged sixty-five, suffering from difficulty in swallowing due to a cancer in the esophagus; on sectioning, it was found to be a pavement epithelial carcinoma. Surgical operation seemed impossible; treatment with radium with the aid of the esophagoscope was instituted, using a tube containing 70 mg. radium bromide 100 per cent, filtering through lead. The tube was suspended by a thread of silk attached to a tooth. This was allowed to remain for 24 hours at intervals during 5 months. The patient became much improved and was well on the road to recovery when he contracted bronchopneumonia and died. At autopsy, it was found that almost complete cure of the carcinoma had been accomplished, the destruction of the neoplastic cells practically completed. However, the metastatic foci had not been affected by the radium treatment. (b) Patient, aged sixty-nine, had difficulty in swallowing solid food and experienced a sensation of choking in the region of the upper neck. There was intense salivation both during the day and night. Examination by means of the esophagoscope revealed a tumor in the esophagus which was responsible for the condition noted. The above radium treatment was instituted. Two days later the patient was able to swallow rice without the aid of water, which had not been the case previously. The patient was discharged in good condition two days later. Six months later, however, he returned with the same condition in the same place. Gastrostomy was resorted to, but this did not prolong the life of the patient. (c) Patient complained of difficulty in swallowing and pain in the region of the xiphoid appendix and in the epigastric region. Immediately above the cardia, a small ulcerous zone was observed with the esophagoscope. Treatment with radium, with gastrostomy, resulted in cure; later, the patient developed pulmonary complications. (d) Patient had cancer in lower part of the esophagus (cardia); treatment with radium for 48 hours; patient discharged two weeks later much improved, but with grave prognosis; died year later. Twelve other cases are cited. The results obtained may be summarized as follows: gastrostomy was not found of particular benefit in these cases; prolongation of life in many cases was for only a few weeks, because the condition of the patient would not allow much interference; treatment with radium bromide in an automatic radium holder gave very good results in most cases, but not so favorable as reported by Guisez; use of the radium holder allows for easy treatment of cancer in the esophagus. Although in many cases the patients did not entirely recover from the condition, in every case an undoubted improvement was noted, and life was prolonged. The patients continued to be able to take food and to gain weight, which would have been impossible had radium treatments not been given. Regurgitation of food was stopped and, in some cases with the aid of gastrostomy, abundant nourishment was possible.

REYN, AXEL. Treatment of lupus vulgaris and other forms of tuberculosis by artificial light. *J. de radiol. et d'électrol., Par.*, August, 1924, viii, 337–350.

The writer reviews the work of Finsen, who is the originator of phototherapy. It was he who used concentrated light for local treatment and unconcentrated light for general treatment in certain diseases. These differ both in principle and in their mode of action. In the local treatment, only a small area of tissue is exposed to concentrated light rays; destruction of bacteria and diseased tissue results from this procedure. In the general light bath, the whole body is exposed to the lights rays; no importance is attached to irradiations of particular parts of the body, but of the body as a whole. At first, the sun's rays were used, but later the voltaic lamp was employed. For local treatment, a voltaic lamp of 50 amperes, 55 volts was used; this was concentrated by means of a series of lenses.

The writer made use of both the concentrated and unconcentrated light from a voltaic lamp in treating lupus vulgaris and other forms of tuberculosis of the skin. The concentrated light seemed to destroy the diseased tissue and cause new tissue to be formed. A great number of cases considered incurable were treated by the use of both methods, with excellent results. The majority of cases were cured and the scars were only slightly visible. Ninety per cent of all cases of lupus vulgaris, including the very serious and apparently incurable cases, were cured; 90 per cent to 100 per cent of the vegetating type were cured. Certain cases are aggravated by application of these

treatments, while others do not respond in any way. Not only are the results of this type of treatment better, but the time in which it is employed is shorter than those previously used.

The use of phototherapy in treating surgical tuberculosis was equally effective. In tuberculosis of the knee, 86 per cent were cured; in tuberculosis of the calcaneum, tarsus and metatarsus, equally good results were obtained. In all these cases, both the concentrated light and the general light baths were used at the same time.

The voltaic lamp is found to be superior to the mercury lamp for this purpose. The length of time of exposure to these treatments was at first 30 to 40 minutes, this time being increased to 2½ hours after two days. If there is fever, due to pulmonary tuberculosis, the time is reduced to 5 to 10 minutes and slowly increased. The general light bath is indispensable in the treatment of tuberculosis usually treated by surgical operation; the concentrated light is, of course, very important. A combination of the two is undoubtedly necessary for best results, both in surgical tuberculosis and in lupus vulgaris.

WACHTEL, HENRI. A case of the formation of a sarcoma in the pelvis; a benign tumor. The effect of roentgenotherapy. *J. de radiol. et d'électrol., Par.*, December, 1924, viii, 543–546.

A girl, aged eighteen, had for two years complained of pain in the right thigh; gradually a tumor the size of a baby's head was formed, which impeded movement of the limb. This was accompanied by progressive cachexia. A roentgenogram showed destruction of the crest of the right ilium and absolute decalcification of the invaded area. The line of demarcation between the healthy and diseased bone was not clear. The lymphatic glands in the lower portion of the abdominal cavity were sensitive. A portion of the tumor was removed; histologic examination showed it to be a giant cell sarcoma. The patient was then treated with the roentgen ray. At the beginning of treatment, the patient weighed 47 kilos; the circumference of the body in the region of the tumor was 88 cm. The first series of irradiations was applied to the anterior surface of the tumor, 10 H units with a current of 1.5 ma., filtered through 2 mm. Al, focal skin distance 24 cm., penetrating rays. This was applied in 5 treatments of 25 minutes on each of 5 days. The day following the first irradiation, the circumference of the body was reduced from 88 cm. to 86 cm., and the next day this was further reduced to 84 cm., and by the fifth day to 81 cm. This treatment was repeated on the posterior side of the tumor; there was no further reduction in size of the tumor, but the general condition of the patient was improved, and she had increased in weight one-half kilo. A further increase in weight to 49 kilos was noted after another month; the patient was able to walk with little pain. The slight erythema over the surface irradiated passed after six days. The roentgenogram at this stage was not perceptibly different than before treatment; there was no repair of bone tissue. Later treatments were not followed by marked reduction of the tumor, but the patient continued to gain in weight and in general health. Since the growth of the tumor had been checked, and since the general state of the patient was satisfactory, roentgenotherapy was discontinued, and the patient considered cured. Six months later the patient was still in excellent health; she was allowed to continue her studies. The roentgenogram at this time showed definite evidence of reconstruction of bony tissue under the tumor. Menstruation became regular again and the patient was in excellent condition when observed for the last time two years later, June, 1924.

It is significant that by this treatment, although the tumor was not removed, the malignancy was arrested, and it was reduced in size to some extent, and the bony tissue was caused to regenerate. It is difficult to determine the number of treatments; it seems best to stop when an apparent amelioration of the symptoms has been obtained, even though reduction in size of the tumor has not resulted.

WALLON, E. Model of needle for radium puncture. *J. de radiol. et d'électrol., Par.*, January, 1925, ix, 31–32.

The treatment of tumors and cancerous infiltrations by radium puncture demands great precision and the use of needles of sufficient length to reach all points of the tumor. Because of the inconvenience and expense of having these different needles, an attempt was made to devise an apparatus which would serve the purpose instead of such varied needles. The needle devised is composed of platinum into the tube of which capillary tubes of radium are placed and fixed with paraffin. It is necessary to be able to introduce and extract easily the tubes of radium. The radium is 15 mm. long and 1 mm. exterior diameter; the interior chamber contains 1.33 mg. of radium, equivalent to 10 microcurie-hours. This dose seems to be best, for it permits of long irradiation. The platinum needles are of three sizes, 28 mm., 41 mm. and 54 mm. long. The interior chamber contains, respectively, one, two or three portions of radium. There is a

gauge on the point, by which the depth of puncture may be determined. The needle is adjustable and is very practical in application. Details of its construction and diagram are given.

WIDAL, F., AND ABRAMI, P. Asthma and hyperthyroidism. Treatment by roentgenotherapy of the thyroid gland. *Presse méd., Par.*, May 31, 1924, No. 44, 473–476.

Reports of 4 cases of asthma with hyperthyroidism are given in which relief from symptoms of both and complete cure resulted from treatment of the thyroid gland by the roentgen ray. The first case, a woman with no significant history, became subject, from no apparent cause, to frequent attacks of asthma. These attacks become so frequent, almost daily, that the patient had hardly any relief from the distressing symptoms. Even during the interval between the attacks, the patient did not have normal breathing. There was also abundance of ropy, gummy sputum. The symptoms were typical of asthma, but it was impossible to determine what protein, if any, was the cause of the condition. Roentgenoscopic examination showed complete absence of pulmonary lesions. It persisted during all seasons of the year, and in different climates, at the seashore and in the mountains. Diet played no part whatever. Emotions, such as anger, and the menstrual periods regularly brought on the asthmatic attacks. The condition is remarkable in its resistance to the usual medications; antispasmodic powders, belladonna, adrenalin, etc., were without effect. Only morphine and codein relieved the symptoms temporarily. There were also symptoms of exophthalmic goiter, the enlarged thyroid gland causing the neck to be noticably larger than normal. Because of the state of the enlargement of the thyroid, it must have begun to become enlarged before the asthmatic attacks started.

Injections of the proper sera and of peptone were without effect. Five months after other methods had proved useless, treatment of the thyroid gland by means of the roentgen ray was begun. Twelve treatments were given as follows: 15 to 20 minutes each week with 2 ma., 80,000 volts, through 4 mm. Al, at a distance of 24 cm.; this was applied to the isthmus, and to both lobes of the thyroid. The first applications of the rays increased greatly the symptoms of both affections, particularly the asthma, so much so that morphine was given. By the fourth week (fourth treatment) the symptoms had subsided somewhat. After the twelfth treatment, the patient was entirely relieved of all symptoms, both of goiter and asthma. This parallel cure of both affections was both definite and complete. Six months after the first treatment, another series of treatments with the roentgen ray was given. Two years after the first treatment, the patient was perfectly normal in every way, and careful examination revealed no symptoms of either condition.

The other 3 cases are quite similar to the above case, with but some minor exceptions, all having asthma, the cause of which could not be traced to the usual sources, and which did not respond to the usual treatments. In all hyperthyroidism was a parallel affection. Exaggeration of symptoms followed the first treatments, but later the conditions were relieved, and complete cures accomplished. It is of much interest to note the parallel evolution of goiter and asthma, and the consequent disappearance of both by irradiation with roentgen ray of the enlarged thyroid gland, and this contrasted with the failure of previously used methods of medications to effect any relief from the symptoms.

WOOLSEY, GEORGE. Late recurrence after radical operation for carcinoma of the breast. *Ann. Surg., Phila.*, December, 1924, lxxx, 932–938.

There is no time limit to the appearance of recurrences. Recurrence is the rule and not the exception, but the chance decreases in proportion to the time after operation. Local regional and metastatic growths are recurrences in the great majority of cases irrespective of the time they appear after operation. Permeation of the fascial lymphatics accounts for most of the recurrences in the other breast and locally. The only way of lessening these is by early operation, wide removal of the deep fascia and postoperative irradiation. Early radical operation before the glands are involved is still the best treatment and avoids most cases of recurrences.

One of the best means of preventing postoperative recurrence is treatment by roentgen radiation. Better results may be obtained in the future by aid of preoperative and postoperative roentgen treatment given by experts, using more intensive penetrating rays with due regard to skin tolerance. Although roentgen treatment has not been in use long enough to permit judging of its results by statistics, still it remains a very encouraging procedure. All cases should have roentgen examination of the chest, spine and upper half of the femur to determine whether there are any internal metastases in the chest or in those bones quite commonly involved. In case there are such metastases, the roentgen therapy should be

directed to these as well, so as to destroy all possible foci of recurrence.

BOTHE, W. The differentiation of radium, mesothorium and radiothorium by measurement of gamma radiation. *Ztscbr. f. Pbysik*, 1924, xxiv, 10–19.

Of all methods for the differentiaton of the 3 sources of gamma radiation: Ra,MsTh and RaTh, the "absorption method" is the simplest and most convenient. Its sensitiveness can be very much increased by a concentric arrangement of the preparation, lead filters and ionization chamber—so much so that it is useful in almost all practical cases.

A description is given of an instrument which after suitable calibration may also be adapted to the quantitative estimation of the composition of sources of gamma radiation. The measurement is made upon preparations of 5 mg. radium equivalents and higher through lead filters up to 11 cm. total thickness; and it permits the definite differentiation between radium and technical mesothorium of any age. Moreover, slight admixtures of mesothorium in radium preparations can almost always be detected with fair certainty. In some cases, it is possible to make quantitative determinations, a field which it is hoped to develop further.

CHARNAUX. Intestinal insufflator for roentgenoscopic examination. *J. de radiol. et d'électrol., Par.*, December, 1924, viii, 547–548.

Intestinal insufflators in use at present for roentgenoscopic examination are objectionable because there is no assurance of constant air pressure in the intestine and there is no means of controlling the pressure. A new apparatus is described which overcomes these objections. A manometer is attached to the tube and is easily visible when in operation, by means of which it is possible to know whether or not the air introduced is being held at the proper pressure. There are other slight modifications for which certain advantages are claimed, such as curvature of the tube, two stop-cocks for controlling the insufflation, type of bulb, etc. The apparatus may be used for other purposes, such as injecting vapors, gas, liquids, etc., into the intestine. A diagram is given showing the detailed structure of the apparatus.

COLEY, WILLIAM B. Prognosis in giant-cell sarcoma of the long bones. *Ann. Surg., Phila.*, April, 1924, lxxix, 561–595.

It seems necessary to modify the opinion strongly maintained by leading pathologists that giant cell sarcoma is always benign and never gives rise to metastases. A tabular report is given upon the end-results in a series of 50 cases, 22 of which are also cited in more or less detail. In all of these cases the diagnosis was made by competent pathologists, experienced in the classification of such bone tumors. There seems little doubt from the evidence here adduced that giant cell sarcoma of the bone can give rise to metastases and therefore can be malignant.

The treatment of giant cell sarcoma of the long bones by radium or roentgen rays is at present in an experimental stage, and the results thus far obtained do not warrant the giving up of the standard method of surgical treatment (curettage) with or without subsequent use of radium or toxins.

Judging from the end-results, the best method of treatment is as follows: exploratory operation with curettage of all the tumor that it is possible to remove; swabbing out the cavity with pure carbolic acid and alcohol or zinc chloride; packing the cavity firmly with gauze to control hemorrhage; putting up the limb in a circular cast if there is danger of pathologic fracture; keeping the cavity clean with Dakin's solution; systemic treatment with the mixed toxins of erysipelas and *B. prodigiosus* for three to four months, supplemented with at least one massive dose of radium in the form of a pack. The dose of radium should be about 12,000 mc-hr. at 10 cm. distance over three areas. Roentgen rays may be used when radium is not available. If the disease recurs in spite of this treatment, it should be repeated a second or even a third time, and if at the end of six months the disease is still progressing, resection or amputation may be indicated. Primary amputation should very rarely be performed in any type of central giant cell sarcoma without prolonged preliminary trial of conservative treatment.

Clinical evidence of malignancy should outweigh the histological evidence of so-called benign giant cell tumor, and in cases of this type amputation should be performed if conservative treatment fails and the disease is not controlled.

CZEPA, A. The problem of the growth-stimulating and function-promoting action of radium and roentgen rays. *Strablentherapie*, 1924, xvi, 913–978.

A good deal that has been written on the subject of stimulation by radiation appears to have been based upon a loose definition of the term "stimulation." The direct result upon cells within an area that is irradiated is one thing and entirely distinct from an indirect

general effect upon the whole organism. When, therefore, "stimulation" is spoken of one must be careful to inquire as to just what is meant. The improvement of a leucemia or cure of a carcinoma is undoubtedly a favorable thing for the body as a whole. This, however, cannot properly be said to be due to a "stimulating" action of the rays. A critical review of the work of recent years, bearing upon this subject is presented with especial attention to these considerations.

There has been an impression that plants subjected to radiation have given positive evidence of cell stimulation; but a careful inspection of the evidence forces the conclusion that a number of the experiments were incorrectly interpreted, and most of the remaining ones yielded such contradictory results as to be unacceptable as proof of a direct roentgen stimulation of the cells without careful corroboration.

When we come to the observations upon animals and human beings the evidence in favor of direct stimulation is even less encouraging. Some of the effects of irradiation which were explained as stimulative effects are shown to be due to general protein action which produces the same effects. The changes following roentgen irradiations and parenteral administration of protein, so far as our present knowledge goes, are very similar to each other. All the present evidence shows there is no sound justification for the assumption of a direct stimulative action upon cells exposed to radiation. Most of the results may, without difficulty, be explained as due to the destructive action of the rays acting in some cases as the origin of the general response in the organism and in others as reactions of wound and necrohormones.

A bibliography of more than 300 references is appended.

FAUCONNIER, A. A roentgen-ray tube autoprotector. The metallic Philips tube. *J. de radiol. et d'électrol., Par.*, November, 1924, viii, 510–512.

The original bulbs used in roentgen-ray work have many disadvantages: they are fragile, difficult to transport because of the fragile nature of the fittings, they become very hot during use, they give off a certain amount of electric charge, there is considerable waste in that the rays are emitted in many directions even though the object on which they are used may be small, some difficulty is experienced in protecting the patient and the operator, etc. The Philips metallic tube has been designed to overcome some of these objections. It is a long, cylindrical bulb in which arrangement of cathode, anticathode, etc., is such as to give a maximum of rays with a minimum of heat; the metallic covering protects the operator and patient and the rays are directed on to a small space only. It is particularly adapted to dental work, and other uses in which small objects are concerned. It is simple, strong and easy to handle. Projection of rays in a direction perpendicular to the anticathode are superior to rays at, say, 60°; therefore, more intense rays may be obtained with this tube than with the older type with the same amount of voltage. Two types of tubes are made for roentgenography, one of them especially for dental use. The principle of the tube is explained in detail and a diagram is given which shows the arrangement of the cathode, anticathode, mirror, etc.

DELHERM, L., AND CHAPERON, ROBERT. The roentgenologic syndrome of aortic hypertension. *J. de radiol. et d'électrol., Par.*, September, 1924, viii, 401–409.

It is very easy to measure arterial hypertension by means of the sphygmomanometer. However, the roentgenologic examination of aortic hypertension will reveal symptoms which are ordinarily confused by certain modifications of the usual signs obtained in the clinical examination; the roentgenogram may also aid greatly in interpreting the clinical findings. The writers have made studies of cases of this nature in an effort to point out the importance of the roentgenogram in such diagnosis. They have also attempted to show the existence of roentgenologic symptoms which forecast arterial hypertension even before it is recognizable clinically.

It is noted that a change in position of the ascending aorta has a relation to hypertension. In the infant, the aorta is usually situated entirely on the left side of the median line and the different portions are contained in the same plane anteroposteriorly. With age, the ascending aorta moves progressively toward the right. This change, which is readily observed roentgenologically, causes a distinct bend in the aorta which in turn leads to increased pressure of the blood because of the diminished size of the vessel at this point. The twisting of the aorta gives a bend to the right at such abrupt angle as to greatly reduce the size of the vessel. Also, the descending aorta moves progressively toward the left with age, the segment becoming more and more prominent in the left pulmonary region. The superior vena cava, which is always vertical and straight in the infant, becomes slightly convex in the adult, this condition becoming more pronounced with age. The vena cava is

pressed to the right by the ascending aorta, which is changing its position in this direction; this appears as exaggerated convexity on the right side of this vein. The aortic hypertension parallels this change and is often caused by it.

A study of these features in the young adult will very often give warning as to the early probability of suffering from hypertension of the aorta according to the position of the vessels as described. By studying a large number of subjects, roentgenologic data on the degree of hypertension corresponding to the various degrees of modifications noted in the vessels named above will offer a basis for prognosis from roentgenograms of individuals before such condition is recognizable clinically. Even now, a fair prognosis may be based upon the size of these vessels, their opacity and their position. The effect of diminished elasticity of the walls of these vessels by infiltration and sclerosis must not be overlooked in making such prognosis from roentgenologic findings.

GUNAWARDENE, H. O., AND LILIENSTEIN, S. The orthometer. *Brit. J. Radiol.*, 1924, xxix, 66–68.

A description is given of a method for determining the size of the heart without the orthodiagram from a knowledge of the anteroposterior diameter of the chest, the width of the shadow on the screen and the distance of the screen from the anticathode. Let A be the distance of the anticathode from the screen, B one-third the anteroposterior diameter of the chest in the mid-sternal line, C_1 the transverse diameter of the heart as given on the screen to the left of the midsternal line, and C_2 the transverse diameter of the heart to the right of the midsternal line. Then

$$\frac{A}{C_1} = \frac{A - B}{D} \text{ also } \frac{A}{C_2} = \frac{A - B}{E}$$

where D is the true distance of the left border from the midline and E is the true distance of the right border from the midline. Thus, D + E, the approximate true diameter, is obtained. A series of scales graded according to these formulas can be constructed so that the final measurements may be read off without the need for calculation.

HARVEY, J. OWEN. Distal filtration with moist metallic pads in conjunction with high-voltage radiations. *Brit. J. Radiol.*, June, 1924, xxix, 224–226.

The moist metallic pad is made as follows: The surface to be irradiated is covered with three layers of single mesh cotton gauze dressing soaked in a solution of 5 per cent copper sulphate. Upon this is placed a layer of medium fine mesh metallic copper gauze; this layer may be doubled or trebled if thought fit. Over this is placed another layer of thin cotton gauze soaked in the same copper sulphate solution. This pad is kept and held in position by a layer of molded wax, which well covers the margins of the pad, the layer of wax being several centimeters thick. It is through this distal filter that the dose of primary hard radiation is administered. The voltage used is 180 kv., filtered through 0.5 mm. Cu, 2 mm. Al and 1 mm. celluloid, with a dose computed to be about one-third of a skin dose at the surface.

The results attained with this technique have proved satisfactory in some cases.

HERBST, WILLIAM P., JR. Malignant tumors of the thyroid. *Ann. Surg., Phila.*, April, 1924, lxxix, 488–494.

All tumors of the thyroid, except sarcomas, appear capable of surgical removal and should be considered operable and a thorough operation performed. This conclusion is based on a study of 290 patients with malignant tumors of the thyroid seen at the Mayo Clinic between 1901 and 1921. In this group there were 19 with sarcoma, 62 with carcinoma, and 102 with malignant adenoma and with inoperable carcinoma. As judged from the mortality returns, sarcoma is the most malignant of the neoplasms, followed by carcinoma, malignant adenoma, and malignant papilloma, in the order given. The results in cases of encapsulated tumors were almost twice as good as in those of non-encapsulated tumors.

The true worth of roentgen-ray and radium therapy cannot be estimated in this group because they have not been used long enough nor on a sufficiently large number of cases. Metastases to the bone is rare in this group of malignancies of the thyroid, the lungs and liver being the most common sites of distant metastases.

HEUSER, CARLOS. Gold filter spectrometry in *x*-ray practice. *Brit. J. Radiol.*, 1924, xxix, 412–419.

Spectrographic studies have demonstrated that the gold filter effectively removes all soft radiation. This was demonstrated in a practical experiment with a gold filter 0.3 mm. thick, while copper 0.5 mm. under the same conditions allowed some soft radiation to escape. The gold also absorbs some of the hard rays. Because of the expense of a pure gold filter it is suggested that a copper gold alloy may be made of equal utility.

KÜSTNER, HANS. The standardization of roentgen dosage measurement. *Strahlentherapie*, 1924, xvii, 1–48.

The most suitable of all units is that suggested by Behnken. This unit is defined as follows: The absolute unit of roentgen-ray dose is delivered by a quantity of roentgen-ray energy which in irradiating one cubic centimeter of air at 18°C. and 760 mm. pressure, with complete utilization of electrons produced in the air (the effects of the walls being eliminated), produces such a conductivity that the quantity of electricity measured with a saturation current amounts to one electrostatic unit. The unit of dose is called "one roentgen" and is designated by "R."

This unit can be readily converted into terms of energy, and as soon as it is possible to determine the energy of roentgen rays of different wave-length, standard measuring instruments can be calibrated to give readings in terms of energy output.

Detailed descriptions are given of the construction and set-up of two standard instruments in which use is made of the ionization method. Because of the strict requirements as to performance, the electrometer selected is the single filament electrometer of Lutz with quartz filament suspension of the adjustable charge, after Wulf.

A number of experiments are reported to demonstrate the sensitiveness of the standard instruments and the reproducibility of their readings. The disturbing factors and sources of errors are considered and means for their elimination pointed out.

A discussion is given of the two fundamental methods for determining hardness of roentgen rays. It is pointed out that determinations made directly from spectra are affected by systematic error in which the tension in a certain case may be in error by as much as 23 per cent. This shows that the spectrometric photographic method cannot lay claim to any very great precision. The spectrograph, however, can in general give very useful data which may be improved in precision by means of photometry. This method is useful in the rough determination of limiting wave lengths and in cases where a large number of spectra are taken under the same conditions, thus permitting the determination of an average of the limiting wave length. It may also be useful in getting qualitative information as to the extension of a spectrum into zones of longer wave length.

A consideration of the effects of filtration of roentgen rays shows that because of the properties of aluminum there is no reality to the terms "practical homogeneity" and "homogeneous point." This point in the case of aluminum is not sufficiently sharp for the characterization of a mixture of rays and it is recommended that the term be abolished because misleading. Copper and zinc are decidedly better filtering agents. Metals of high atomic weight are unsuitable and have no advantage over copper. For a definition of a mixture of rays, it appears that the semi-thickness of copper is a better measure than the limiting wave length.

LACASSAGNE, A., LATTÈS, J. AND LAVEDAN, J. Experimental study of the biological effects of polonium introduced into the organism. *J. de radiol. et d'électrol., Par.*, January, 1925, ix, 1–14.

Fernau and his associates have studied the effect of polonium on the blood constituents and have shown that injection of 10 to 40 electrostatic units into rabbits causes an increase in the number of leucocytes, followed by leucopenia. Injection of strong doses causes an immediate decrease in leucocyte count. This leucopenia is intense, falling from 9,200 leucocytes to 10 in 8 days, and followed by death of the animal (rabbits were used). The number of erythrocytes was affected but little. At autopsy of those animals killed by the strong doses, the blood was not coagulated in the vessels, there were pulmonary hemorrhages, and atrophy of the spleen. Polonium has been found in the spleen, liver and kidney fourteen days after injection.

In the present work, an electrostatic unit of polonium has been established as corresponding to 2.14×10^{-10} gr. of polonium. Its relation to radium is discussed as to its relative value as a radioactive substance. Strong doses of polonium caused death of rabbits with involvement of certain organs. Injection of 500 E.S.U. caused death in six days; symptoms were loss of appetite, restlessness, progressive dyspnea; the urine diminished daily and there was abundant sediment; after the fourth day, the urine contained blood. At autopsy, the spleen was congested; visceral hemorrhage in the region of the lungs, subpleural, etc. In other animals, marked leucopenia was noted, the number of white cells falling from 7,200 to 0 in ten days; the mononuclears increased from 59 per cent to 100 per cent up to the ninth day, and the polynuclears decreased from 44 per cent to 0 per cent by the eighth day. The number of red cells remained normal. The coagulation time of the blood was increased parallel with the fall in leucocyte count, and at the time of death of the animals, the blood was incoagulable. The number of blood platelets fell from 225,000 to 83,000. Death from

acute nephritis followed six days after injection of one animal. The injection of moderate doses (200 to 400 E.S.U.) caused death of only one of six animals. All of them showed symptoms of nephritis analogous to those of the preceding series; chronic lesions were produced. The leucocyte count dropped from normal to 550, then went up to 5,740, in one case; the mononuclears fell from 55 per cent to 30 per cent, the polynuclears increased from 45 per cent to 70 per cent, the platelets dropped from 260,000 to 62,000, the coagulation time increased from 8 minutes to 37 minutes at six days, and then was reduced to 14 minutes at thirty days; the erythrocytes remained normal. Injection of feeble doses (120 E.S.U.) showed a reduction of leucocytes, and then an increase to normal; the mononuclears and polynuclears changed slightly, but after a time regained about their normal proportion. The histologic lesions produced were those of nephritis, the degree of destruction of tissue varying with the dose given.

LEE, BURTON J., AND CORNELL, NELSON W. A report of 87 primary operable cases of carcinoma of the breast admitted to the New York Hospital prior to April 1, 1919. *Ann. Surg., Phila.*, September, 1924, lxxx, 400–418.

Sufficiently accurate data were obtained from 75 of these cases to yield a conclusion as to end-results after the five-year period. The five-year results in this series show 15 per cent alive and with no evidence of disease after surgical treatment.

Only 10 of the patients received postoperative roentgen treatment and most of these were treated by technique which today is considered only reasonably efficient. Nevertheless the average duration of life of these patients was three years and four months after operation. The average length of life of 61 patients who had received no radiation was three years, and this group included all of the favorable cases without metastases to the axillary nodes. These figures are suggestive but not conclusive.

The roentgenographic appearance of early chest metastases may be characteristic a considerable time before the appearance of any subjective symptoms. Chest plates are not infrequently passed as negative when true evidence of extension of the disease to the chest is present. The roentgenographic evidence of early metastases consists of hazy, line-like streaks along the bronchi extending in a radiating manner from the hilum out into the parenchyma of the lung. It is usually bilateral and is generally more pronounced upon the side corresponding to the primary tumor. There may be an ill-defined mottling having almost the appearance of miliary tuberculosis and there may also be enlargement of the nodes at the hila.

Pain is the first symptom of metastases to bones and the patient may complain before the roentgenogram will reveal definite evidence of disease. In the order of frequency the bones involved are spine, pelvis, ribs and femur. In the present series, metastasis to the spine was known to have occurred in 8 patients.

LOMON, AND COMANDON. The roentgenologic cinematograph. *J. de radiol. et d'électrol., Par.*, October, 1924, viii, 433–437.

The practical use of cinematography in recording the cardiac contractions is described in some detail. Aside from the immediate value of such pictures, there is also the future use of these in watching the changes in heart contractions at stated intervals; comparison of these pictures may be of much value in following the condition of certain cases. In the method described, 25 roentgenograms can be made per second. The Coolidge tube is not suitable for this purpose, for it will not function under tensions higher than 100,000 volts and 150 to 250 amperes for a period of seconds. In these tubes, the metal at the anticathode in one second at the above intensity not only fuses, but volatilizes. For this purpose, tubes used for 180,000 volts in roentgenotherapy were employed. The operator is protected by a lead screen; an aluminum sheet 0.5 mm. thick is used for the patient. This protects the skin of the subject and prevents contact with the tube. Under these conditions, erythema results only after 20 seconds' exposure. The subject is placed between the tube and the screen as in regular roentgenologic work. The screen and cinematographic apparatus are solidly fixed on a rigid frame; it is essential that this be accurately done. The white roentgenographic plates of cadmium tungstate were successfully used, but the writers substituted tungstate of lime plates, of the intensifier type, but with large grain. The aperture is F 1.55; the objective is composed of substances through which ultraviolet rays will pass, quartz, uviol glass and glycerine. A hypersensitive film made by Eastman and one made by Pathê Cinema gave equally good results. Because of the extreme heat and tension on the tubes, the writers established 5 seconds as the maximum exposure. In this time, at least 2 complete cardiac cycles may be obtained; the time allowed is, then, quite sufficient. From 17 to 18 images per second seem to give

best results, although 25 per second are possible. A great number of positive prints may be made from the negatives. There seems to be a definite use for such records of cardiac contractions in certain cases and the method given is sufficiently accurate to produce clear roentgenograms, in which the various stages of contraction are easily noted.

M'Crea, E. D., M'Swiney, B. A., Morison, J. W., and Stopford, J. S. B. The normal movements of the stomach. *Brit. J. Radiol.*, February, 1925, xxx, 48–67.

This investigation undertaken for the British Medical Research Council was carried out on the stomach of the rabbit, cat, dog and man. In the animals, two methods of investigation of the movements were used: (a) by direct observation under anesthesia, and (b) by roentgen examination after feeding a barium meal.

In the rabbit the contractions of the stomach fall into two groups: (1) contractions having their origin either in the region of the cardia on the lesser curvature pass toward the pylorus and cease at the incisura angularis. At the latter point a constriction ring forms and reforms; (2) contractions of the pyloric antrum may have the following forms: (a) rhythmical, the whole antrum contracting and relaxing, (b) tonically contracted with waves passing over it, and (c) peristaltic without concentric contraction being distinguishable. Cardiac and pyloric contractions may occur separately or together; and when they coexist they are often separated from one another by an apparently immobile area.

This type of two-phase gastric motility in which peristalsis of the body and systole and diastole of the pyloric antrum coexist is predominant also in the dog and in man. It is but occasionally observed in the cat. In this animal the usual form of gastric motility consists of one form of movement throughout its extent. The peristaltic wave in the cat's stomach begins near the esophageal orifice and sweeps uninterruptedly with increasing depth to the pylorus.

In man the two-phase type of movement is the common one but a modification of the one-phase is occasionally present. From the description of the musculature of the human stomach as given by Forssell this structure suggests, as in the rabbit and dog, a two-phase form of movement.

It is probable that the type of gastric movement present is to some extent governed by the consistency and type of the food, the degree of tension upon the wall of the stomach and the muscular form of the wall. The movements of the corpus ventriculi and of the pars pylorica may occur with differing rhythms.

Mottram, J. C. On the skin reactions to radium exposure and their avoidance in therapy; an experimental investigation. *Brit. J. Radiol.*, May, 1924, xxix, 174–180.

Experiments were carried out (mainly on the tails and flanks of rats) to discover the factors controlling the variations in skin reaction to irradiation by radium. The radium applicator contained 110.2 mg. radium bromide spread over an area 2 × 2 cm. and screened with 0.12 mm. silver. Exposure to heat up to about 45°C. gave negative results; but exposure to cold near 0°C. increases the skin reaction. Blanching the skin and stoppage of the blood flow either with or without congestion decreased the skin reaction. It would seem that these findings may fall under the simple law that an increased blood flow conditions an increased reaction and a diminished blood flow a decreased reaction. Clinically, there is evidence that a flushed skin is especially sensitive to exposure.

Several attempts to promote an increased blood flow during exposure were unsatisfactory because no method of controlling the effect could be found. For instance, mustard oil causes an erythema but any increased reaction after radiation might well be due to the summation of the effects of the two agents. Where deep-seated lesions are being treated it will be of advantage to apply pressure to the superficial tissues during exposure in order to decrease their sensitiveness to radiation. It seems likely that the advantages claimed for ice compresses as used in France are due to their weight rather than their temperature. It is doubtful whether the promotion of an increased blood flow can be taken advantage of clinically to raise the sensitiveness of a tissue toward radiation. Experimentally this association has not been decidedly demonstrated. It is to be remarked that fibrotic tumors with a poor blood supply are commonly less sensitive than more quickly growing tumors well supplied with blood, that the spleen and bone marrow in which the tissue is bathed in blood are especially sensitive; but it may well be that other factors determine their differences.

Why an increased blood flow conditions an increased sensitiveness and *vice versa* is hard to explain. The obvious hypothesis would be that the radiation causes some injurious substance to be produced in the blood which is constantly renewed as fresh blood flows in. However, we have no knowledge of any such action of radium.

PAGNIEZ, PH., RAVINA, A., AND SOLOMON, I. Roentgen rays and blood coagulation. Therapeutic applications. *Presse méd., Par.*, June 25, 1924, No. 51, 545–548.

Many workers have reported beneficial effects in controlling time of blood coagulation by means of the roentgen ray. In the review of the literature given, some of these cases are mentioned. A girl seven years old suffering from purpura, nose-bleed and anemia was subjected to irradiations of the spleen in doses of 2H; the purpura disappeared and the epistaxis was stopped. The cure was rapid and definite. The anemia was corrected and the erythrocyte count brought back to normal. The results here are attributed to stimulation of the blood-forming centers, medullary and splenic. This shows that, although roentgen rays in strong doses will destroy certain cells, in weaker doses they exert a stimulating effect. In 1920 Stephan began using irradiations with the roentgen ray on the spleen as a means of diminishing the coagulation time of the blood. Cases of grave hemorrhage were checked and entirely cured by this means; this effect became apparent within four hours after irradiation. The increase in coagulability of the blood was accompanied by an increase in the content of fibrin-ferment in the blood. He claims that the rays exert their effect on the reticuloendothelial cells of the spleen, and not on lymphatic tissue. Other workers have accomplished the same result by irradiation of other organs, such as the liver, and the intestine. This action is due, according to the various authors, either to increase in fibrin-ferment, prothrombin or fibrinogen. Excellent results have been obtained by these workers in the following cases: purpura, hemoptysis, hemophilia, spontaneous epistaxis, hematuria, and grave postoperative hemorrhages.

The authors have studied the coagulation time of the blood of 24 subjects, the usual method for determining coagulation being used. Irradiations of the spleen was then accomplished in the usual manner, a dose of 500 R (2 H, 5) being given. Of these, 17 were treated and samples of blood taken after a few minutes and after one hour. Fifteen of this number showed a decrease in coagulation time, 1 was not modified, and 1 showed apparent increase in coagulation time. Seven in another series in which the spleen was not observed roentgenoscopically, showed results as follows: 5 showed shortened coagulation time, and 2 lengthening of this time. The dose given (500 R) is one-sixth the "erythema dose." Appreciable shortening of the coagulation (to ¼ the normal) time was obtained by such doses as 100 R. The efficiency of irradiation of the spleen is amply verified. Irradiation of the liver, using 500 R, gave similar results, a shortening of the coagulation time about equal to that obtained by similar treatment of the spleen. The same treatment applied to the femoral artery and the triangle of Scarpa gave quite the same results as in treatment of the spleen. Irradiation of the humerus with 500 R gave similar results in 3 out of 4 cases, as did also treatment of the carotid region, as well as in the palm of the hand. These tests prove that acceleration of the coagulation time of blood by irradiation is not confined to the spleen alone. Four to seven days after irradiation, the time of coagulation returns to normal. This does not hold true *in vitro*, under which circumstances irradiation has no effect whatever, even by 1000 R.

MISCELLANEOUS

CALDWELL, GEORGE T. Lymphoid hyperplasia in the thyroid gland. *Southern M. J.*, March, 1925, xviii, 177–180.

"In the rountine examination of portions of the thyroid gland removed surgically, it became evident that one of the common pathologic findings is a hyperplasia of the lymphoid tissue in the gland."

In 1912, Hashimoto described three thyroids in which the acini were largely replaced by numerous lymph follicles with prominent germinal centers. In other regions the lymphoid tissue was diffusely scattered. In 1896, Riedel described a form of chronic inflammation of the thyroid which changed the gland into a bulky tumor composed of dense fibrous tissue. This later became known as Riedel's struma. Ewing believes that Riedel's struma is just a late stage of the lymphoid hyperplasia. In the cases observed by Ewing the whole gland was involved; the growth was active for a few months and then became slower or stationary; the regional lymph nodes were unaffected; one large tumor produced dyspnea but receded rapidly under radium. Ewing uses the term "benign granuloma." Ewing believes the condition rather common, and Graham of Cleveland stated that he had seen 14 cases which had not yet been published.

The etiology is still unknown. It is thought to be inflammatory in nature but the opinion has been expressed that it is part of a general lymphoid hyperplasia.

The small clumps of lymphoid cells which are more or less constantly present in exophthalmic goiter are not readily confused with the epithelial hyperplasia in this disease. There seems to be a tendency for the two types of hyperplasia to occur together.

When present in small amounts the lymphoid tissue is scattered through the stroma as small clumps while a second group is characterized by the formation of well-defined germinal centers such as are seen in the tonsils and in the lymphoid tissue of the appendix. Fibrous tissue is not especially abundant in the glands in which this striking hyperplasia is found.

The type of gland here described is of relatively frequent occurrence. The writer has seen 29 during the past five years. Only three of these cases contained sufficient amount of fibrous tissue to give the characteristics of woody thyroiditis or typical Riedel's struma.

All of the cases occurred in females and most of them in middle life, although one of the most striking was in a thirteen year old girl.

Although some clinicians hold that this condition is infectious in origin, secondary to some focus elsewhere, no definite relationship to any of the acute infections has been demonstrated and no lesions suggesting tuberculosis have been seen. The findings are not characteristic of a local infection and it is doubtful if the term chronic thyroiditis is appropriate. A careful bacteriologic examination of these glands has not yet been made. Whether the glands in the writer's patients would eventually assume a fibrous type is not evident.

Conclusions. "Lymphoid hyperplasia is often the outstanding alteration in portions of thyroid gland removed surgically.

"Prominent lymph follicles with large germinal centers often develop in glands which lack any marked alteration of the usual types of goiter, and in which epithelial hyperplasia is entirely missing or present only to a slight degree.

"The appearance of these glands contrasts so sharply with the recognized thyroid changes as to constitute a distinct pathological entity, and there is some evidence that they are also distinct clinically."

PRICE, WESTON A. Dental infections and related degenerated diseases. Some structural and biochemical factors. *J. Am. M. Ass.*, Jan. 24, 1925, lxxxiv, 254–261.

Patients with dental infections can be divided into three groups on the basis of the structural change that develops in the supporting structures of the infected teeth as the result of the presence of a given type of dental infection. In the first group this condition will produce about the apex of the tooth a large zone of rarefaction which will frequently be connected with the external surface by a fistula. The medullary structure of the surrounding bone opens quite readily into the periapical chamber, the trabeculae in the surrounding osseous tissue are approximately normal in size, and the proportion of medullary material to osseous tissue is as much as or more than 50 per cent of the total mass.

The second group gives a similar appearance except that the fistula tends to be closed, and the zone of rarefaction is surrounded by a zone of condensed bone with marked reduction in the proportion of medullary tissue and increase in osseous tissue adjoining the chamber formed in the bone about the apex of the infected tooth.

In the third group dental infection produces much less of a zone of rarefaction about the apex of the involved tooth, in some cases amounting to a very slight absorption as compared with the previous groups. The trabeculae are not so marked in the alveolar bone and there is evidence of more or less diffuse condensation surrounding the area.

Studies were made on the relation of periodontoclasia to susceptibility to rheumatic group lesions and to the dominance of special tooth lesions in patients and their families; and experiments were performed to determine the changes in ionic calcium and blood morphology due to inoculations with *Streptococcus viridans* and of the blood calcium changes produced by infected teeth.

The evidence obtained suggests the following interpretation of the relation of the local dental phenomena to the systemic defense. A person with a normally high defense as expressed by the absence of recurring rheumatic group lesions tends to react vigorously as close to the source of that infection as possible against invading organisms and toxic materials from the openings at the apices of involved teeth. This is why such patients show the large zones of rarefaction. This large zone of radiolucence generally consists of highly vascularized defensive tissue. When the latter is adequate the rest of the body is protected. When this normally high defense is affected, the invading organisms and their toxic products pass into the body and the defense must now be made in the various organs and tissues. In this case the local dental involvement ceases to become uncomfortable because of the absence of the local defense reaction. That particular organ or tissue in the body which has been most weakened now is in danger of breakdown, or that factor termed "inherited susceptibility" may then play its rôle. This may be the reason why heart disease, etc., runs in families.

Tuberculosis tends to be associated with decalcifying processes about dental infections and in patients without a previous tendency to dental caries. The prognosis in a case of tuberculosis is suggested by the presence of a zone

of condensing osteitis about a zone (previously developed) of rarefaction. May we not have here a new approach to the study of both the streptococcal, rheumatic group, degenerative diseases and the nonstreptococcal diseases such as tuberculosis and cancer?

SANTÉ, L. R. The new department of radiology of the St. Louis City Hospital. *Radiology*, November, 1924, iii, 402–407.

A description is given of the layout and equipment representing an investment of $100,000 housed in a three-story building. The various interesting details of construction are described; in the high tension roentgen-ray therapy section the various compartments are constructed entirely of metal plaster lath and barium sulphate plaster. The grounded metal lathing forms a cage giving complete electrical protection to the patient. The barium plaster 2½ inches thick is equivalent to over ¼ inch of lead to the penetration of gamma rays or to 200 kv. roentgen rays. The department also contains equipment for the preparation of emanation tubes. So far as possible all high tension overhead wiring and roentgen-ray machinery have been eliminated from the actual work rooms. All the machinery and most of the high tension wiring is placed on the third floor and the high tension terminals merely come through the ceiling wherever they are required on the floor below. All the high tension switches are on the third floor and are operated by ropes running through conduits in the walls. Suitable pilot lights indicate the position of the switch. This eliminates noise, diminishes the amount of dirt collecting on the overhead wiring and lessens the danger of electrical shock.

SCHINZ, HANS R. Fundamental problems of radiation biology. *Klin. Wchnschr.*, 1924, iii, 2349–2355; 2397–2400.

This is a bibliographic review in which 161 references are quoted.

Is there such a thing as specific action of roentgen rays? As a matter of fact, although we are accustomed to speak of specific action of radiation and of specific sensitiveness of certain cells to roentgen energy we really mean a relatively selective action. A consideration of the biological facts involved brings out clearly that "general sensitiveness" and "roentgen sensitiveness" of living structures are identical terms. The mere fact that of all external physical agents, roentgen rays appear to have unique properties does not alter the situation. With roentgen rays we merely possess better facilities for controlling the quality, quantity and localization of the external agent. In this aspect and only in this do we find the real nature of roentgen therapy. The differing sensitivity of various living structures, no matter how important they may be practically in radiation therapy, are not of fundamental significance to roentgen biology but constitute a basic principle of general biology.

There are a number of factors that are involved in the selective action of roentgen rays and it should be remembered that their effects may be additive, subtractive, or may even multiply each other. Various tissues are sensitive to varying degrees and the so-called retrogressively metamorphosing tissues are mostly more sensitive than the permanent tissues. The metamorphosing tissues are defined as similar to what the botanists term meristemes. They comprise the epidermis, sebaceous and mammary glands, hair follicles, nail matrix, the partly cornifying flat epithelium of the mouth cavity, esophagus and vagina, the intestinal epithelium, the lymphatic and myeloid tissues, and the seminal and follicular epithelium. In short, they may be summarized as the tissues with matrix, tissues with exfoliating holocrine glands, and growing tissues. They show different degrees of radiosensitivity; and in this group the relatively radiation-insensitive are the melanosarcomas and certain branchiogenic carcinomas. The most sensitive are the lymphoid tissues, the lymphocytomas, myeloid tissue, ovarian follicles and folliculomas, seminal epithelium and seminomas; somewhat less sensitive are spindle cell sarcomas and basal cell carcinomas; while still less sensitive are the epidermis, gland carcinomas, etc.

Within one and the same metamorphosing tissue there exist differences in sensitiveness between the various cell categories. In the lymphoid organs certain lymphoblasts appear to be resistant; in the seminal epithelium the active spermatogonia are most sensitive, the reserve spermatogonia are quite sensitive; the washed out spermatocytes are less sensitive and the spermatids are most resistant. In malignant tumors the old elements are stated to be more sensitive than the young ones.

Within any cell group the nucleus is more sensitive than the other cell elements. Moreover, the nucleus shows a higher sensitiveness during mitosis than during the resting stage. There are also variations in sensitiveness during the stage of mitosis; maximum sensitiveness appears to occur in the stage of the equatorial plate although statements are not all in agreement on this.

Physical, chemical or physiological factors which definitely determine roentgen sensitiveness and its variations have to date not been demonstrated. There is a certain dependence upon temperature in general, and a certain relation between roentgen sensitiveness and anabolic life processes. Qualitative differences in sensitiveness occur independently of the above enumerated conditions. The effective roentgen sensitiveness of a certain living object is the resultant of all factors.

From the standpoint of general physiology and cellular pathology, the author recognizes eight successive degrees of cellular injury (hypobiosis) by roentgen radiation. A single, mild dose may cause merely a brief cessation of cellular division (first degree of radiation hypobiosis); or there may be also a degeneration of directly affected mitoses (second degree); or even a temporary secondary effect (third degree). There may be a permanent depression in cell division (fourth degree); or an influence upon differentiation (fifth degree). An optimal effect on tumors, for instance, would be obtained if a single dose could be made to injure all the resting cells in a lethal heredito-cellular manner (sixth degree); or cause necrosis after a long or a short latent period (seventh and eighth degrees).

SITTENFIELD, M. J. Present studies in experimental cancer. *Radiology*, January, 1925, iv, 1–6.

If, in the main, the important questions about carcinogenesis are still unanswered it is because we are still ignorant of many factors which control normal growth and development. It is desirable, therefore, that we have more precise knowledge of the stimulatory and inhibitory bases of growth in general in order to correlate them with the normal repair of tissues and with the changes into malignant proliferation. The experimental work in this direction of the past two or three years has brought to light definite and undeniable proof that a long-continued irritation will cause traumatized tissues to throw off normal restraint and finally to succumb to lawless and unrestrained new growth.

The problem that confronts us is how to prevent malignant transformation of a normal cell, and once the malignant transformation has set in, how to destroy the cell. If we can also make accurate measurements of the activating and depressor substances of different cellular elements and body fluids we may then at least feel that we are approaching a fuller knowledge of the essence of the cancer problem.

SLYE, MAUD. The fundamental harmony shown in all essentials in spontaneous neoplasms and in true experimental tumors. *Radiology*, January, 1925, iv, 7–20.

The essential harmony existing between spontaneous neoplasms and artificially produced tumors is the fact that they have all been shown to depend fundamentally upon the inherited predisposition of the animal's tissues. In grafted tumors the success of the experiment depends fundamentally upon the inherited tendency of the animal's tissues to regenerate normally and furnish proper conditions of attachment and food instead of abnormally as in the case of spontaneous cancer. In liver, stomach and intestinal tumors resulting from parasitic infestation the success of the experiment depends upon the inherited tendency of the animal's tissue to attempt regeneration under such irritation, and the violence of the method which overthrows such regenerative powers as the animal's tissues may possess. Many animals and many strains thus far tested both by artificially introduced and by naturally ingested parasites have been unable to regenerate the irritated tissues either normally or abnormally and their organs have merely gone to pieces in degenerative changes.

From tar painting the same type of squamous cell carcinoma of the skin arises as occurs spontaneously from similar chronic skin lesions produced in mice by many other causes. In all probability, when this type of experiment has been thoroughly tested out it will be found to depend upon the inherited tendency to skin carcinoma which could equally well be produced by other types of chronic attacks upon a susceptible skin.

The fundamental difference between spontaneous neoplasms and artifically produced tumors seems to be that the spontaneous tumor is the product of the animal's own inherent metabolism, that is the inherited tendency to regenerate abnormally under various assaults upon the tissues. On the other hand, to date, all experimentally produced tumors seem to indicate that the violence of the technique may have overthrown inherent cancer resistant mechanisms with the probability at the same time of the overthrow of other vitally fundamental metabolic mechanisms.

These harmonies between spontaneous and artificially produced tumors give promise that it may be possible to strengthen the cancer resistant mechanism, since there seem to be varied grades of such resistant mechanisms, and there are evidently resistant mechanisms that cannot be overthrown by the most

violent and long-continued methods yet attempted.

TERRILL, H. M. A quick reading *x*-ray spectrometer. *J. Optical Soc. Am.* (*etc.*), August, 1924, ix, 189–192.

The instrument described was designed to combine precision with speed of operation. The distinguishing feature is the use of large gear wheels operated by worms to obtain angle settings accurately and rapidly without the necessity of reading verniers. Two such instruments have been constructed for the Institute of Cancer Research at Columbia University. The slits are of an improved type, the lead plates being closed by opposing micrometer screws. Throughout all adjustments, they are maintained accurately at right angles to the beam of roentgen rays and the edges are bevelled to avoid reflections from the slit edges. Provision is made for using this instrument with either a large or a small ionization chamber. The gear wheels and worms are the vital parts of the instrument and presented the chief constructional difficulties. The hand wheels controlling the worm shafts are 5½ in. in diameter and are subdivided to permit readings to 12 seconds of arc. The crystal table carries a sliding plate with micrometer adjustment for sliding the crystal exactly over the center. The crystal may be removed and upon being replaced can be returned to within a few seconds of its original setting.

SANTEE, HAROLD E. Fractures about the upper end of the humerus. *Ann. Surg., Phila*, July, 1924, lxxx, 103–114.

An analysis is given of 75 fractures of the upper end of the humerus, consecutively observed. The individuals in this series had an average age of 50.4 years; 30 of the patients were women. An analysis of these fractures is difficult. Grouping on purely anatomical lines is difficult because many of the shoulder injuries when first roentgenographed on a flat plate in two planes will appear to fall into one group, whereas later observation with muscles relaxed and the patient in comfort may bring out lines of fracture of different characteristics.

Fractures of the anatomical neck were rare, occurring in 14 cases. Isolated fracture of the greater tuberosity occurred 5 times. This fracture should be recognized as a major injury in the disability it produces. Fracture of the lesser tuberosity was encountered in 2 cases, but it was impossible to discover the mechanism of the production of this injury because one case was an alcoholic and the other psychopathic. In each case the fractured lesser tuberosity was displaced well down alongside the rim of the glenoid cavity and remained in this position of displacement after reduction of the head.

The remaining 64 fractures of this series involved the surgical neck of the humerus.

The disability resulting from these fractures is usually marked and prolonged mainly because of associated injury of the soft tissues adjacent to the fracture. Wide abduction and external rotation is the position of choice for convalescence and the conditions are best maintained by bed and traction suspension treatment with a frame. The intelligent cooperation of the patient aids in the regaining of function.

SCHWAAB, A. Again "a child of the roentgen ray." *Presse méd., Par.*, July 5, 1924, No. 54, 566–567.

The writer reports another case of the harmful effects of the roentgen ray on the fetus in pregnancy. A pregnant woman was treated with the roentgen ray in an effort to eliminate a fibroma of the uterus. The development of the fetus was checked and premature delivery by cesarean section was necessitated. The weight of the child was only 1,600 grams at birth, and only 2,000 at four months. The head was abnormally small, also. Instances are cited in which similar results of roentgenotherapy have been reported. It seems quite certain that treatment of fibroma of the uterus, which requires strong rays, if given to pregnant patients will result in arresting the development of the fetus. Therefore, it is advisable to know whether or not the patient is pregnant before such treatment is contemplated, and if pregnancy is doubtful, treatment should be delayed until the patient is sure, in which case it will not be given until after delivery.